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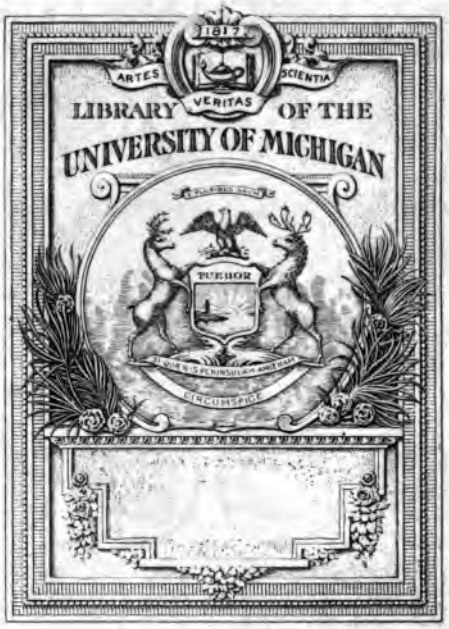
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PANAMA

THE ISTHMUS AND THE CANAL

BY

C. H. FORBES-LINDSAY

AUTHOR OF

"India, Past and Present", "The Philippines, Under Spanish and American Rules", "America's Insular Possessions", etc.

ILLUSTRATED

PHILADELPHIA

THE JOHN C. WINSTON CO.

1906

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Affected dispatch is one of the most dange things to business that can be: it is like that whicl physicians call predigestion, or hasty digestion, u is sure to fill the body full of crudities, and s seeds of disease: therefore measure not dispatc the time of sitting, but by the advancement o business; and, as in races, it is not the long strid high lift, that makes the speed; so in business keeping close to the matter, and not taking of i much at once, procureth dispatch. It is the ca some only to come off speedily for the time, or tc trive some false periods of business, because they seem men of dispatch; but it is one thing to ab ate by contracting, another by cutting off. . The ripeness or unripeness of the occasion m well weighed; and generally it is good to comm beginnings of all great actions to Argus with hi dred eyes, and the ends to Briareus with his hu hands; first to watch and then to speed.

— Ba

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I.

PANAMA.

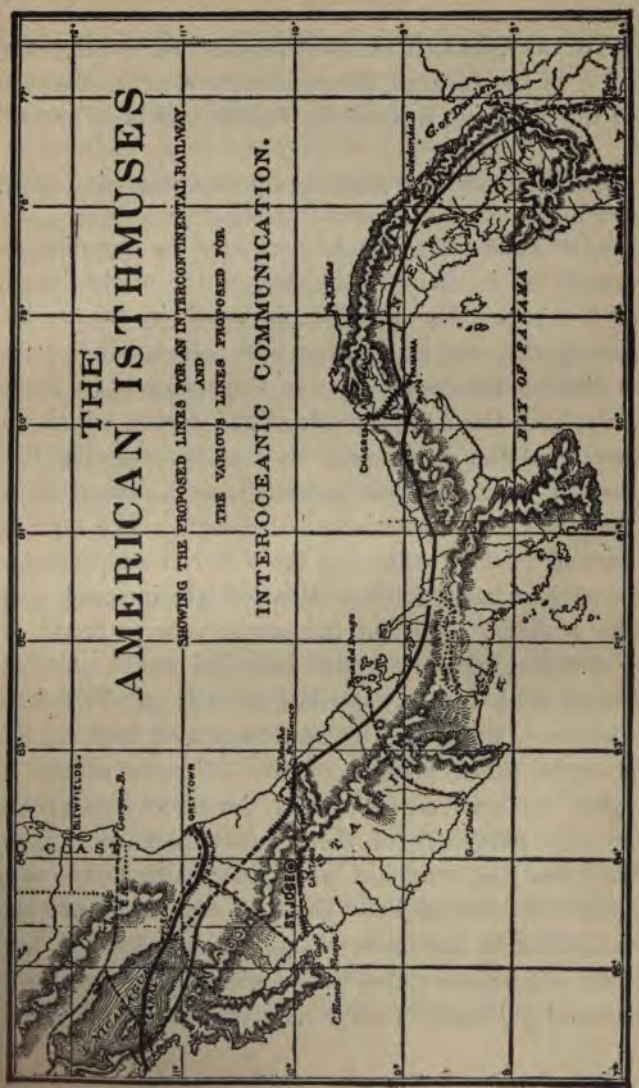
THE AMERICAN ISTHMUS UNDER SPAIN.

Early Settlements on the Spanish Main — Preparations for Exploring the Pacific Coast — The Search for a Strait Through the Isthmus — The Establishment of Overland Communication — The First Survey of the Isthmus of Panama — The Ill-fated Darien Expedition — Cortes Establishes a Transcontinental Route — Investigation of the Nicaragua Route — Disintegration of Spain's American Colonies.

On the early morning of the twenty-fifth of September, in 1513, a small party of men made their laborious way up the densely covered face of a steep ridge. One, keen of eye and with determined countenance, pressed forward eagerly ahead of his companions. When, at length, he reached the summit, a vast expanse of water stretched before him on either hand. Balboa had discovered the Pacific Ocean. Vasco Nunez de Balboa was a man of extraordinary intellect, and it is not improbable that something of the true significance of this new knowledge dawned upon his mind even in these first moments of discovery. Perhaps he, first of all contemporary explorers, realized that the Tierra Firma of Columbus was not the Ultima Thule of sixteenth

advising him to fit out an expedition and recommending the Indian village of Darien, on the Gulf of Uraba, as a favorable site for a settlement on account of the reported presence of gold in the vicinity. Encisco adopted the advice of Balboa. The expedition arrived in due course and a town was established on the Isthmus and named Santa Maria de la Antigua del Darien. It had the distinction of being the first episcopal see upon the mainland and of containing the oldest church in the American continent.

Balboa soon rose to a position of importance among the colonists of Tierra Firma. He learned from the Indians that a great sea lay beyond the range of mountains that traversed the Isthmus, and lost no time in investigating the statement. With a small force of Spaniards and Indian guides Balboa succeeded, not without great difficulty, for the whole way was through dense jungle and over swamps, in reaching the ocean, of which he formally took possession in the name of the King of Spain. During this journey across the isthmus the Spaniards heard of a rich land to the south abounding in precious metals. Balboa planned the conquest of this country, and it is more than probable that Pizarro, who was his companion on this occasion, shared his designs. Had the former lived to pursue his energetic and ambitious career Pizarro might never have found the heroic place which he occupies in history.


THE
AMERICAN ISTHMUSES
SHOWING THE PROPOSED LINES FOR AN INTERCONTINENTAL RAILWAY
AND
THE VARIOUS LINES PROPOSED FOR
INTEROCEANIC COMMUNICATION.
BAY OF PANAMA
G. of Darien
Caledonia B.
Chagres
Panama
Gorgona B.
BLEWFIELDS
GREYTOWN
ST. JOSE
C. Blanco
Nicaragua
Canal

In 1515, Balboa received the reward of his enterprise in the form of the appointment of Adelantado of the Southern Sea, as the Pacific had been named.

PREPARATIONS FOR EXPLORING THE PACIFIC COAST

In the following year he prepared to organize expedition to the south by way of the newly dis ered ocean. The problem involved in the un taking was one to daunt a less bold spirit. T suitable to the construction of ships were to be f only upon the Atlantic side of the divide, whi cessitated the tremendous task of transportin bers over a route that presented great difficu the passage of an unencumbe [illegible] The onerous labor of collecting th [illegible] and it on their backs to its desti [illegible] imp the Indians, of whom thous [illegible] gether for the purpose and i [illegible] tomed work by the mercile [illegible] masters. Many [illegible] struggle for a [illegible] many respects [illegible] modern succes [illegible] dreds of the w [illegible] their number fell [illegible] their lives in the u [illegible] four brigantines wer [illegible] sea and put together o [illegible]

began to prevail that a solution to the problem would be found in the territory of Mexico. It was in accordance with this idea that Gil Gonzales was despatched from Spain to the New World. Gonzales had authority to use the vessels which had been built by Balboa, but Pedrarias refused to deliver them to him. Gonzales was not to be balked by this denial, however. He immediately took to pieces the two caravels with which he had arrived and transported them to the Pacific coast by the route which Balboa had hewn out. The reconstructed ships were soon lost and the party built others, in which they proceeded north in January, 1522, to Fonseca Bay. At this point the leader, with one hundred men, continued the exploration by land. [illegible] Nicaragua was discovered and a settlement [illegible] ly a[illegible] wards made upon its shore, the I[illegible] ng [illegible] subjected. The new discovery a[illegible] and projects relating to the much [illegible] route. It was at first reported th[illegible] isted from the lake to the South Se[illegible] ate examination failed [illegible] tion. In 1529, Dieg[illegible] In [illegible] considerable force, [illegible] aragua and its eastern [illegible] tion of the San Ju[illegible] the Desaguadero, ext[illegible] ally emerged from its [illegible] continued down the coast [illegible]

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later period an important commerce was conducted over this route by vessels making ports in Spain, the West Indies and South America. Thomas Gage, the English priest who visited Nicaragua in 1637, mentions this traffic as in existence at that time.

THE ESTABLISHMENT OF OVERLAND COMMUNICATION.

Pending the discovery of a maritime channel between the two oceans, the Spanish authorities had decided to establish permanent land communication across the Isthmus of Darien. Under Charles the Fifth a line of posts was maintained from coast to coast. Nombre de Dios was made the Atlantic port and the Pacific terminus was located at old Panama, which was created a city in 1521. A road was at once constructed between these two points, which crossed the Chagres at Las Cruces. Great difficulties were surmounted in building this highway. Much of the route lay over swamps that had to be filled in. Several streams were spanned by bridges and vast masses of rock were removed to facilitate the passage over the mountains. The way was paved and, according to Peter Martyr, was wide enough to accommodate two carts abreast.

About ten years after the establishment of this route a modification of it came into use. Light draft vessels began to sail from Nombre de Dios along the coast and up the Chagres as far as Cruses, where the

road met the stream, and thence the journey was completed by land. In the closing years of the sixteenth century, Nombre de Dios, which had been repeatedly condemned in memorials to the Crown, as "the sepulcher of Spaniards," was abandoned in favor of Porto Bello, with a location and other natural advantages decidedly superior to those of the former terminus.

EARLY TRADE OF PANAMA.

This interoceanic communication was of the utmost value to the Spanish Crown after the conquest of Peru, and the isthmian territory grew in importance year by year. The vast treasure that was extracted from the mines of the south came to Panama in the first stage of transit to the Royal Treasury. From the Pacific port it was carried to Porto Bello on pack-horses, and thence was shipped to Spain. Upon the arrival of vessels from the mother country, fairs were held at Cartagena and Porto Bello. Thither came merchants from far and near and caravans from Panama. An extensive trade was conducted at these periodical marts and the goods brought from Spain found their way through Panama to South and Central America and even to the mainland and islands of Asia. Thus was demonstrated at an early date the logical trend of trade and the great advantages of a trans-isthmian route.

The idea of an artificial passage had already been mooted. It is said that Charles the Fifth, in 1520, ordered the Isthmus of Darien, or Panama, to be surveyed with a view to ascertaining the practicability of a canal. There is no record of this survey nor any evidence that it was ever made. Fourteen years later the matter was revived. The local authorities were instructed to employ able men to closely examine the country lying between the Chagres River and the Pacific with a view to determining the most feasible method of effecting a junction and creating a through waterway for ocean-going ships. The instructions were carried out but the report of Governor Andagoya was so extremely discouraging that the Emperor abandoned the project.

A CHECK TO CANAL PROJECTS.

The policy of Philip the Second with regard to the American possessions was very different from that of his father. The former was averse to the expansion of his empire in the New World and distinctly antagonistic to the plans for an isthmian canal. He reasoned with astuteness that the existence of a water route through the continent of America would give easy access to his new possessions on the part of other nations and in time of war might be of greater advantage to his enemies than to himself. The pol-

icy of Philip was maintained for two centuries after his death by succeeding rulers, but maritime communication continued to be the subject of much thought and speculation.

During this period of quiescent policy on the part of Spain the most notable event in the history of the Isthmus was furnished by the disastrous attempt of William Paterson to establish a colony in the province of Darien. In 1695 the Scotch Parliament, with the approval of William the Third, authorized the formation of a company to plant colonies in Asia, Africa and America and to carry on trade between those continents and Scotland.

THE ILL-FATED DARIEN EXPEDITION.

Paterson cherished a scheme of stupendous colonial commerce, the Darien Expedition being but the initial step in the enterprise. Toward the close of the year 1698, five vessels having on board twelve hundred Scottish settlers anchored in a bight which they called Caledonia Bay, a name it retains at this day. The colonists were received in friendliness by the Indians and purchased from them the land upon which the settlement of New Edinburgh was made. It was Paterson's design, based upon sound enough reasoning and knowledge previously acquired from the buccaneers of the West Indies, to extend his posts to the Pacific Ocean and open up a trade with

the countries of the South Sea and Asia, in the manner which had been so profitable to Spain. He had not, however, anticipated the effect of the climate upon his northern-bred emigrants. Before any steps could be taken towards the contemplated extension of the operations, the colony was decimated by disease. The misery of the settlers was increased by the loss of the supply-ship on which they had depended for fresh provisions, and eight months after the landing a pitiful remnant of the original expedition abandoned the settlement and returned to Scotland. But before this disaster had become known at home other vessels with additional emigrants were despatched to the new colony. These made an effort to revive and maintain the settlement, but with no better results than those which had befallen their predecessors. The numbers of the later comers had become sadly reduced when they were attacked by the Spaniards. After a feeble resistance they capitulated. So weak were the survivors that they could not reach their ships without the aid of their enemies.

Thus ended the Darien Expedition with the loss of more than two thousand lives and the expenditure of vast sums of money.

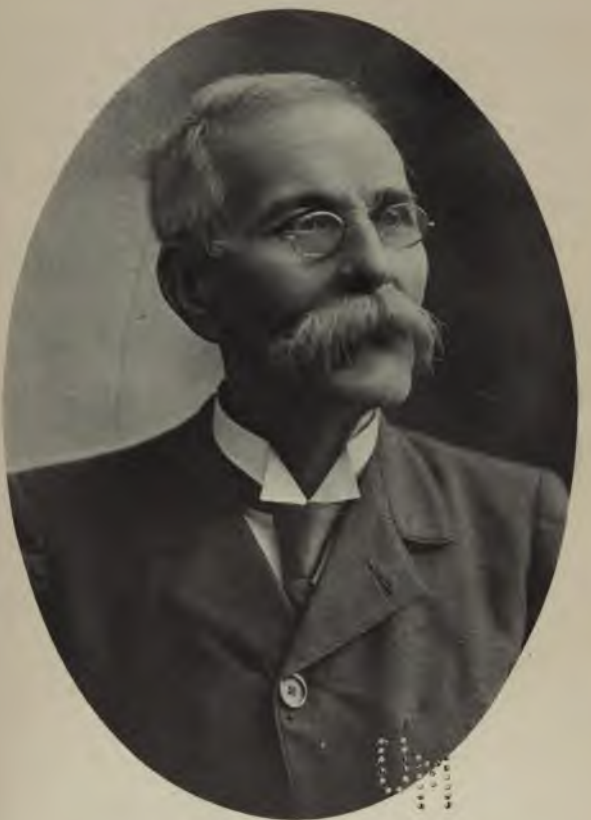
In this section of the country the Spaniards completely failed to secure the friendship of the Indians or to effect their subjection. Their amicable reception of the Scotch immigrants and their invariable

readiness to assist the buccaneers in their incursions against the Spanish settlements indicated the persistent hatred with which they regarded the first invaders of their land. The Darien region was wild in the extreme and abounded in secret passes and safe retreats. From their fastnesses the Indians made frequent raids upon the Spanish posts and retired by trails which were known only to themselves.

In the latter half of the eighteenth century, during the governorship of Andres de Ariza, a determined effort was made to establish permanent communication between the coasts at this part of the Isthmus. Plans were laid for a line of military posts to be connected by a road which should run from a point on Caledonia Bay to a terminus on the Pacific Ocean. The project was put into operation, but met with such formidable resistance on the part of the inhabitants that the Spanish authorities became convinced of the futility of their endeavors. In 1790 they entered into a treaty with the Indians, agreeing to disband the garrisons and withdraw from the country.

CORTES ESTABLISHES A TRANSCONTINENTAL ROUTE.

It will be remembered that in the first quarter of the sixteenth century Cortes received implicit instructions from the Crown to use every resource at



AMADOR GUERRERO
President of the Panama Republic.
1904-1908.

his command in a search for the longed-for strait. In pursuit of this object the coast of Mexico was carefully examined and the Coatzacoalcos River explored. Montezuma afforded valuable assistance in this investigation by furnishing descriptions and maps of certain portions of the country. Whilst these efforts failed of their principal object, they had important results. Cortes established a transcontinental route along the course of the Coatzacoalcos, over the divide, and down the Pacific slope to Tehuantepec. This line of communication soon gave birth to an extensive trade between Spain and her provinces on both coasts of America as well as some parts of Asia. The Ead's ship-railway of modern days was planned to follow practically the same line as this early route of Cortes.

Towards the end of the eighteenth century there were discovered at Vera Cruz some cannon of ancient date which bore the mark of the old Manila foundry. This discovery aroused speculation as to how the pieces of artillery had been brought to the Atlantic coast of Mexico. It seemed improbable that they had been transported around the continent, especially when it was remembered that the only commercial intercourse with the Philippines had been through the Pacific port of Tehuantepec and over the route established by Cortes. This trade-way had long since been abandoned, but interest in it was at once revived by the incident which has been recited, and

a remembrance of its former importance prompted the viceroy of Mexico to institute an investigation.

By this time it had become an accepted idea that maritime communication between the oceans could only be secured by the creation of artificial waterways. Two engineers were directed to explore the country from the mouth of the Coatzacoalcos to Tehuantepec with a view to ascertaining the practicability of a waterway from ocean to ocean. This was the first canal project entertained for this region.

INVESTIGATION OF THE NICARAGUA ROUTE.

The report on this exploration, which included a cursory survey, was not such as to encourage the institution of operations. It had the effect, however, of stimulating the interest in the subject and in 1779 the feasibility of connecting the Nicaragua lakes with the sea was investigated by royal command. Manuel Galisteo, to whom the task had been intrusted, passed an opinion unfavorable to the project. Nevertheless, a company was formed in Spain, with the patronage of the Crown, to carry out the undertaking, but nothing effective ever came of it.

Galisteo's expedition had been accompanied by the British agents at Belize in a private capacity. Upon their return they made highly favorable representations to their Government, stating that the project

was entirely feasible and not accompanied by any difficulties that the engineering capabilities of the day need fear to encounter. This report made a deep impression in England and when, in the following year, war broke out between that country and Spain an effort was made to gain possession of the Nicaragua country. In 1780, an invading force was organized at Jamaica. Captain Horatio Nelson was in command of the naval contingent, and in his despatches stated the general purpose of the expedition as follows: "In order to give facility to the great object of the government I intend to possess the Lake of Nicaragua, which for the present may be looked upon as the inland Gibraltar of Spanish America. As it commands the only water pass between the oceans, its situation must ever render it a principal post to insure passage to the Southern Ocean, and by our possession of it Spanish America is divided in two." The English were successful in their encounters with the Spaniards, but in the climate they found an irresistible enemy that forced them to abandon the enterprise. Of the crew of Nelson's ship, the *Hinchinbrook,* numbering two hundred, more than eighty fell sick in one night, and only ten survived the return of the expedition to Jamaica. The hero of Trafalgar barely escaped with his life after a long illness.

At the beginning of the nineteenth century Spain retained possession of the entire territory embraced

in the question of interocean communication, but she had made no practical progress towards its settlement. Neither had she added materially to the available knowledge of the world on the subject, for the results of Spanish exploration and survey in this direction have never been made public. With the exception of the re-opened communication by way of Tehuantepec the old Spanish overland routes had all fallen into disuse, and traffic between the mother country and the possessions on the west coast of America and in the Pacific Ocean was maintained by vessels sailing round Cape Horn and the Cape of Good Hope. Humboldt visited Mexico at about this time and recorded the ignorance that prevailed amongst the local authorities regarding the interior of the country. He stated that there was not a single mountain, plain, or city from Granada to Mexico of which the elevation above the sea was known.

DISINTEGRATION OF SPAIN'S AMERICAN COLONIES.

Ere this the entire civilized world had become keenly interested in the question of an interoceanic canal, and the investigations of Humboldt commanded wide attention. Amongst other effects, they aroused the Spanish Government to action in the matter. In 1814 the Cortes passed an act authorizing the construction of a canal through the Isthmus

and providing for the organization of a company to carry out the enterprise. Before anything of importance had been accomplished under this legislation the revolutions occurred which wrested from Spain her provinces in South and Central America. With the loss of territory went the opportunity for profit and glory by connecting the oceans.

In 1819, the states of New Granada, Ecuador, and Venezuela united in forming the Republic of Columbia, under Simon Bolivar; in 1831 they separated into three independent republics. In 1823 the Federal Republic of the United Provinces of Central America was formed by the union of Guatemala, San Salvador, Honduras, Nicaragua, and Costa Rica. These political changes, in what may be termed the canal region, opened up new possibilities in connection with the much-mooted question of a waterway and claimed the attention of capitalists and statesmen of all the commercial nations. From this time the matter is taken up with definiteness of purpose and never allowed to rest. Plans and negotiations of various kinds involving all the possible routes follow fast upon each other until we arrive at the inception of the work by the United States Government and the assurance of its accomplishment.

SHORTER COURSES OF TRANSPORTATION.

Some of the immense advantages to be conferred on the world by the Panama Canal can be seen by a glance at the map.

II.

PANAMA.

CANAL EXPLORATION.

Concession to an American from Nicaragua — Baily's Exploration of the Nicaragua Region — The First Survey of the Panama Line — Development of the United States as a Factor in the Canal Question — The Vanderbilt Company in Nicaragua — An Able Survey of the Nicaragua Route — The Construction of the Panama Railroad — An Important Senate Investigation — Establishment of the Interoceanic Canal Commission — Report of the Interoceanic Canal Commission — Various Ship Railway Projects.

Early in 1825, the Republic of Central America, through its representative at Washington, conveyed to Henry Clay, then Secretary of State, a desire for "the co-operation of the American people in the construction of a canal of communication through Nicaragua, so that they might share, not only in the merit of the enterprise, but also in the great advantages which it would produce." Clay was fully alive to the importance of the project, the execution of which, he said, "will form a great epoch in the commercial affairs of the whole world." He returned a favorable answer to the proposition and promised an investigation on the part of the United

States of the claims advanced in favor of the Nicaragua route.

CONCESSION TO AN AMERICAN FROM NICARAGUA.

In 1826, the Republic of Central America, having grown impatient of the delay on the part of the United States, entered into a contract with Aaron H. Palmer of New York for the construction of a canal capable of accommodating the largest vessels afloat. The work was to be started within a year from the date of the agreement. The contract was to remain in force as long as might be necessary for the reimbursement of the capitalists engaged, in the amount of the money invested, together with ten per cent per annum, and for seven years after such reimbursement the company was to receive one-half of the net proceeds of the canal. At the expiration of the seven years in question the property was to be transferred to the Republic. It was expressly stipulated in this contract that the passage should at all times be open to the ships of friendly and neutral nations without favor or distinction.

Having secured his concession, Palmer endeavored to organize a construction company with a capital of five million dollars. The utter inadequacy of this amount is illustrative of the lack of explicit information which characterised all similar enterprises until quite recent times. Palmer failed both in America

and in England to enlist the necessary financial aid and the contract was never acted upon.*

After an abortive attempt to complete arrangements with a Dutch company, the Central American Republic again addressed the Government of the United States with an offer to grant to it the right to construct a canal. In response to a recommendation of the Senate growing out of these overtures, President Jackson commissioned Charles Biddle to visit Nicaragua and Panama, with instructions to examine the different routes that had been contemplated and to gather all the information and documents procurable bearing upon the matters in interest. No satisfactory results followed this mission. A message was sent to the Senate to the effect that it was not expedient at that time to enter into negotiations with foreign governments with reference to a transisthmian connection. The truth is that the Government and its agents were not sufficiently assured as to the stability of the new republics and feared to create relations that might lead to political embroilment.

BAILY'S EXPLORATION OF THE NICARAGUA REGION.

Meanwhile the active interest in the canal question was not confined to the United States. In 1826 an

* House Report No. 145, 30th Cong., 2nd session.

depth of eighteen feet. He offered an alternative plan which would reduce the summit level to 122 feet above the lake but would necessitate the connection of two of his stations by a tunnel over two miles in length. The report frankly estimated the difficulties involved in the undertaking, and closed with the statement that although he could not speak confidently as to the feasibility of the route, which had never been surveyed, he believed that a continuation through the Tipitapa into Lake Managua and thence to the port of Realejo was worthy of serious consideration. Whilst these investigations were proceeding in the north, examination of other probable routes was being made. In 1827 President Bolivar commissioned J. A. Lloyd to survey the Isthmus of Panama with special regard to the possibilities of rail and water communication. Despite the fact that this was the first transcontinental route, the scientific knowledge of the territory was most insignificant. The geography of the strip was imperfectly known and the relative heights of the oceans or the altitude of the mountains separating them had never been ascertained.

THE FIRST SURVEYS OF THE PANAMA LINE.

Lloyd made a careful survey from Panama to a point within a few miles of the mouth of the Chagres. He seems to have considered plans for a

canal premature, but said that should the time arrive when such a mode of communication might be favorably entertained the route of the Trinidad River would probably prove the most desirable. He recommended for immediate purposes a combination rail and water route to take the place of the roads then in use from Chagres and Porto Bello to Panama. His plan contemplated a short canal from a point on the Bay of Limon to the Chagres, the use of that river along its tributary, the Trinidad, to a favorable spot for a junction, and thence a railroad to the coast. As to the terminus he was divided in opinion on the relative advantages of Cherrera and Panama. The former had the merit of shortening the distance, whilst the latter was the capital and an already well-established port.

The Republic of Colombia was disrupted in the year 1831 and the Panama region became a part of New Granada. In 1838, that Republic granted a concession to a French company authorizing the construction of highways, railroads, or canals from Panama to any desired point on the Atlantic coast. This company spent several years in making surveys and forming plans. The results were submitted to the French Government with a view to enlisting its aid in carrying out the undertaking. The project was presented in an extremely optimistic light and as one comparatively easy of accomplishment. The concessionnaires claimed to have discovered a depression

in the mountain range which would permit of a passage at no greater height above the average level of the Pacific than thirty-seven feet. The company's statements excited extraordinary interest, and in 1843 Guizot, then Minister of Foreign Affairs, instructed Napolean Garella to proceed to Panama, to investigate the company's statements, and to make an independent examination of the entire situation.

Garella's report,* which was an able treatment of the subject, heavily discounted the claims of the Salomon company and led to its failure. An interoceanic canal was recommended as the only means of communication that could adequately meet the future demands of commerce. Garella agreed with Lloyd that the Atlantic terminus should be in the Bay of Limon rather than at the mouth of the Chagres. That river would be met by his canal near its junction with the Gatun. The reported low depression which had raised hopes of the practicability of a sea-level canal at a reasonable cost, could not be found. Garella suggested the passage of the divide by means of a tunnel more than three miles in length. The floor of this tunnel was to be 325 feet below the summit, 134 feet above the ocean, and the water level 158 feet above extreme high tide at Panama. The canal was to have a guard lock at each entrance and the summit level was to be reached

* Reprinted in House Report No. 322, 25th Cong. 3d session.

by eighteen locks on the Atlantic slope and sixteen on the Pacific. The water supply was to be derived from the Chagres through two feed-canals. The Pacific terminus was placed at Vaca de Monte, about twelve miles south of Panama. Garella estimated the cost of a canal on these lines at about twenty-five million dollars. At the cost of an additional three millions he calculated that a cut might be made in place of the tunnel.

DEVELOPMENT OF THE UNITED STATES AS A FACTOR IN THE CANAL QUESTION.

"About the middle of the century a succession of great events vastly increased the importance of a maritime connection between the two oceans to the United States. The dispute with Great Britain as to the boundary line west of the Rocky Mountains was settled by the Buchanan-Packenham Treaty in 1846, and in August, 1848, an act of Congress was passed under which Oregon became an organized territory. The war with Mexico was commenced early in 1846, and by the terms of the Guadalupe-Hidalgo Treaty, which closed it in 1848, California was ceded to the United States. Before the treaty had been ratified gold was discovered there, and in a few months many thousands from the eastern part of the country were seeking a way to the mining regions. To avoid the hardships and delays of the

journey across the plains or the voyage around the continent, lines of steamers and packets were established from New York to Chagres and San Juan del Norte and from Panama to San Francisco, some of the latter touching at the Pacific ports in Nicaragua. For a while those travelling by these routes had to make arrangements for crossing the isthmus after their arrival there, and were often subjected to serious personal inconveniences and suffering as well as to exorbitant charges.

THE UNITED STATES INSTITUTES NEGOTIATIONS FOR A RIGHT OF WAY.

"The requirements of travel and commerce demanded better methods of transportation between the Eastern States and the Pacific coast, but there were other reasons of a more public character for bringing these sections into closer communication. The establishment and maintenance of army posts and naval stations in the newly acquired and settled regions in the Far West, the extension of mail facilities to the inhabitants, and the discharge of other governmental functions, all required a connection in the shortest time and at the least distance that was possible and practicable. The importance of this connection was so manifest that the Government was aroused to action before all the enumerated causes had come into operation, and negotiations

were entered into with the Republic of New Granada to secure a right of transit across the Isthmus of Panama." * This object was effected by a treaty that was ratified in June, 1848.

In the following year, Elijah Hise, the representative of the United States in Nicaragua, negotiated a treaty with that republic. By its terms Nicaragua undertook to confer upon the Government of the United States, or a corporation composed of its citizens, the exclusive right to construct and operate roads, railways, or canals, or any other medium of communication by means of ships or vehicles, between the Caribbean Sea and the Pacific Ocean and through the territory of the former state. The concessions made by this treaty were extremely liberal, but in consideration of them it was required that the United States should pledge itself to the protection of Nicaragua and should hold its army and navy and any other effective resources it might be able to command available for the defense of the Latin-American republic against foreign aggression. Nicaragua was prompted in this negotiation by the desire for aid in withstanding the policy of Great Britain, which at that time appeared to be directed toward extending her control of the Mosquito coast to the lower waters of the San Juan.

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* Report of the Isthmian Canal Commission. Washington, 1899–1901.

Residence Street in Cristobal.

The United States Government was not prepared to assume the responsibility involved in this treaty, in making which Hise had exceeded his authority, and it was not ratified. Another convention was formulated with the object of furthering the plans of The American, Atlantic and Pacific Ship Canal Company, composed of Cornelius Vanderbilt and others. Although this fell through, its purpose was effected by the Clayton-Bulwer Treaty of 1850.

THE VANDERBILT COMPANY IN NICARAGUA.

This agreement required the contracting parties to support such individuals or corporation as should first commence a canal through Nicaragua. It practically insured the interests of the company in whose behalf the negotiations of the year before had been conducted. The Republic granted to the Vanderbilt company the exclusive right, for a period of eighty-five years, to make a ship canal from any point of the Atlantic coast to any point on the Pacific coast of Nicaragua, and by any route. The contract also gave to the company the exclusive right to construct rail or carriage roads and bridges and to establish steamboats and other vessels on the rivers and lakes of the territory as accessories to its enterprise. It was also provided that in case the canal or any part of it should be found to be impracticable, then the company should be privileged

to substitute a railroad or other means of communication subject to the same conditions. In order to facilitate the operations, the company was incorporated by the Republic of Nicaragua in March, 1850. In the following year the arrangement was modified for the convenience of the company, by the granting of a new charter to enable the subsidiary operations on the inland waters to be separated from those connected with the canal proper. Under this charter the Accessory Transit Company immediately established a transportation line from Greytown up the San Juan and across Lake Nicaragua, by steamboats, to Virgin Bay on the western shore of the lake, and thence by stage coaches, over thirteen miles of good road, to San Juan del Sur. In connection with this route regular steamship communication was maintained with New York on one side and San Francisco on the other. This line proved a boon to the gold-seekers and was traveled by thousands on their way to and from California. It was obliged to close, owing to the disturbed condition created by the Walker expeditions, but at a later date was reopened under a new charter by another company.

The American, Atlantic and Pacific Ship Canal Company did not deem any of the surveys or reports that had previously been made of the Nicaragua country sufficiently reliable to determine their route upon, and Colonel Orville Childs

of Philadelphia was engaged to direct a thorough instrumental survey of the entire region.

AN ABLE SURVEY OF THE NICARAGUA ROUTE.

Colonel Childs' report was submitted to President Filmore in March, 1852, and by him to two United States army engineers, by whom the plan was pronounced as entirely practicable, although they recommended some modification of its details. In view of the fact that the British Government was jointly pledged with the United States to protect the enterprise, the plans were subjected to examination by English experts. These concurred in the opinion of the American engineers.

Nothing further was done by the Vanderbilt company towards the construction of a canal, but the Childs' report has always been of great value to later investigators in an examination of the subject. In 1856, Nicaragua declaring that the company had failed in the performance of certain clauses of the contract, revoked the concession, annulled the charters, and abolished the corporation. The company disputed the right of the Republic to take this action and made several futile attempts to re-establish its status.

In 1858, despite the continued protest of the former concessionaries, the Government of Nicaragua considered itself free to enter into a new contract.

This it did jointly with Costa Rica. The grantee in this case was Felix Belly, a citizen of France. The rights and privileges accorded to him under this agreement were very similar to those which had been enjoyed by the Vanderbilt company, and the organization which he proposed to create for the purpose of accomplishing the work was to be similarly protected by the terms of the Clayton-Bulwer Treaty. But the contract with Belly contained a clause insuring to the French Government the right to keep two ships of war in Lake Nicaragua as long as the canal remained in operation. This novel feature in the agreement no sooner came to the knowledge of the United States than that country lodged an emphatic protest with the Governments of Nicaragua and Costa Rica. The proposed arrangement was characterised as obnoxious. It was pointed out that "the neutrality and security of these interoceanic routes constitute a great portion of their value to the world, and that the exclusive right to any one nation to exercise armed intervention would be just ground for dissatisfaction on the part of all others." No attempt was made to enforce the offensive clause and, as the company failed to put its project into execution, the grant was cancelled. More than once negotiations have been blocked by political obstructions and for many years American statesmen have been averse to the idea of a waterway across the American Isthmus under foreign control.

In the meantime the demand for transcontinental transportation created by the discovery of the gold-fields of California led to the building of the railroad across the Isthmus of Panama. This line was opened early in 1855 and, whilst it afforded very valuable service, it stimulated rather than satisfied the desire for a ship canal. Exploration and survey were actively prosecuted in the Darien region by the governments and private citizens of the United States, Great Britain and France. By this time precise information was available as to the conditions obtaining along the Nicaragua and Panama routes, but the interior of the eastern section of the Isthmus was still unknown except to the Indians, although it had often been traversed by Spaniards.

EXPLORATIONS IN THE DARIEN REGION.

This region had the obvious advantage of short distances between the oceans and there were good harbors available on either coast. So, when the difficulties of the tested routes had been proved, attention turned to the southern extreme of, what may be called, the canal area, in the hope that the physical features of that region might present difficulties of less magnitude than those existing in the sections already surveyed. This hope found justification in the common report that the mountains of the interior offered a low depression which had long been

used by the Indians as a portage for their canoes when traveling from one ocean to the other. Indeed, there was a tradition of a long-existing uninterrupted waterway from coast to coast which was said to have been effected by cutting a short canal from the upper reaches of the Atrato to a small stream, the San Juan, emptying into the Pacific.

In the examination of this region three general lines were followed — those of San Blas, Caledonia Bay, and the Atrato River. Each of these names indicates the Atlantic terminus of the route, but there were many variations in the courses followed and the contemplated points of termination at the Pacific ranged over three hundred miles of coast. These investigations, in which the United States freely lent its assistance to private endeavors, had good results in the extension of topographic and geographic knowledge of the country and seemed to warrant further efforts in the same direction.*

AN IMPORTANT SENATE INVESTIGATION.

In the year 1866, the Senate, with a view to determining the scope and direction of further investigation of the interoceanic canal question, requested the Secretary of the Navy to furnish all the avail-

* Details of these expeditions in the Darien district may be found in Senate Ex. Doc. No. 1, 33rd Cong., 2nd session, and House Ex. Doc. No. 107, 47th Cong., 2nd session.

able information pertaining to the subject and to ascertain whether the Isthmus of Darien had been sufficiently explored.

Secretary Welles responded, in the following year, with a voluminous report * by Admiral Charles H. Davis. This document enumerates nineteen canal and seven railroad projects in the isthmian country extending from Tehuantepec to the Atrato. It excludes from consideration the plans relating to Tehuantepec and Honduras as being infeasible and meritless.

With reference to the eight proposed routes through Nicaragua, Admiral Davis says: "It may safely be asserted that no enterprise, presenting such formidable difficulties, will ever be undertaken with even our present knowledge of the American isthmuses. Still less is it likely to be entered upon while such strong and well-founded hopes are entertained by the promoters of the union of the Atlantic and Pacific oceans of finding elsewhere a very much easier, cheaper, and more practicable route for a canal in every way suited to the present demands of commerce and navigation."

He condemns a project that had strong advocates at the time, with these words: "The examination of the headwaters of the Atrato, of the intervening watershed, and of the headwaters of the San Juan,

* Senate Ex. Doc. No. 62, 39th Cong., 1st session.

satisfactorily proved that nature forbids us altogether to entertain an idea of a union of the two oceans in this direction." The Admiral gives a general description of the other lines in Panama, Darien, and the Atrato valley. He states that "the Isthmus of Darien * has not been satisfactorily explored" and that "it is to the Isthmus of Darien that we are first to look for the solution of the great problem of an interoceanic canal. For these reasons and because "there does not exist in the libraries of the world the means of determining, even approximately, the most practicable route for a ship canal across the isthmus," he recommends the further investigation of the subject in this region.

ESTABLISHMENT OF THE INTEROCEANIC CANAL COMMISSION.

President Grant, in his first message to Congress, recommended an American canal. That body promptly adopted a joint resolution providing for more extensive exploration by officers of the Navy, and the chief of the Bureau of Navigation was authorized to organize and send out expeditions for

* Until quite recently the words Darien and Panama were used interchangeably with reference to the strip of land now more generally designated as the Isthmus of Panama. It is in this broader sense that Admiral Davis uses the term "Isthmus of Darien."

this purpose. In 1872 the Interoceanic Canal Commission was established. Its members were General A. A. Humphreys, Chief of Engineers, United States Army; C. P. Patterson, Superintendent of the Coast Survey; and Commodore Daniel Ammen, Chief of the Bureau of Navigation of the Navy. Under the directions of this commission explorations were conducted in various parts of the isthmian territory.

The Tehuantepec route was surveyed by a party of which Captain Shufeldt had charge. It was found that under the most favorable conditions a canal along the Tehuantepec line would be more than one hundred miles in length, with a summit level at least 732 feet above the sea and requiring one hundred and forty locks. This report, confirming as it did the conclusions of Admiral Davis and other experts, put the Tehuantepec route out of the question for all future time.

At about the same time (1872), an expedition under Commander Edward P. Lull, assisted by A. G. Menocal, as chief civil engineer, surveyed the entire Nicaragua route, following the line taken by Childs, except for a slight deviation in the passage of the divide beyond the lake. Commander Lull's report was favorable. It included a detailed plan for a canal at an estimated cost of $65,722,137.

Whilst this work was progressing in the north, Commander Selfridge and other officers of the

United States Navy were engaged in surveying the most promising lines in the Darien region. In 1875 the Panama route was minutely surveyed by Lull and Menocal. They reported in favor of a course 41.7 miles from the Bay of Limon to the Chagres, ascending its valley and that of the Obispo to the divide, and descending the Pacific slope by the valley of the Rio Grande to the Bay of Panama. The line as marked out in this report has been followed in general in subsequent plans.

REPORT OF THE INTEROCEANIC CANAL COMMISSION.

The Interoceanic Commission now had before it the reports of the expeditions which have been mentioned and, in addition, plans and surveys relating to every route in any degree practicable from one end to the other of the canal country. Its report,* which was unanimous, was returned in February, 1876, and embodied the following conclusion: "That the route known as the Nicaragua route, beginning on the Atlantic side at or near Greytown; running by canal to the San Juan River, thence . . . to . . . Lake Nicaragua; from thence across the lake and through the valleys of the Rio del Medio and the Rio Grande to . . . Brito, on the Pacific coast, possesses, both for the construction and maintenance of a canal, greater advantages

* Senate Ex. Doc. No. 15, 46th Cong., 1st session.

and fewer difficulties from engineering, commercial, and economic points of view than any one of the other routes shown to be practicable by surveys sufficient in detail to enable a judgment to be formed of their respective merits."

Meanwhile Lieutenant L. N. B. Wyse, as the representative of a French syndicate, was negotiating with the Colombian Government for a concession, which he secured in 1878. An account of this important contract and of the Panama Canal Company, which operated under it, will be given in a later chapter.

VARIOUS SHIP RAILWAY PROJECTS.

Whilst the report of the Interoceanic Commission was generally accepted with regard to the infeasibility of the Tehuantepec route for a ship canal, it appeared to James B. Eads to offer special advantages for a ship railway, and in 1881 he secured a charter from the Mexican Government conveying to him authority to utilize it for that purpose. Eads' plan was entirely feasible and no doubt would have been carried to a successful conclusion had he lived, but with his death in 1887 the project was abandoned.

In 1860 Sir James Brunless and E. C. Webb proposed to Napoleon the Third a ship railway across the Suez Isthmus instead of the projected

canal, but the proposition was rejected by de Lesseps. The same engineers prepared plans for the Government of Honduras, in 1872, for a similar transportation line from Pureto Caballos to Fonseca Bay, to carry ships of twelve hundred tons. The Republic failed to obtain the money necessary to carry out the plans.

The year after Eads' death the celebrated Chignecto Ship-railway was commenced, after years of preparation. It is now in successful operation over seventeen miles between the Bay of Fundy and the Gulf of St. Lawrence. The projected Hurontario Railway, of a similar character, will be sixty-six miles in length. Mere distance, however, whilst it enhances the cost of such an undertaking, does not necessarily increase the difficulty of it.

Eads' proposed line adhered in general to the course mapped for a canal. The length of the railway was to have been 134 miles. The summit of 736 feet is reached by easy grades, the heaviest being less than fifty-three feet in the mile. The railway was designed to carry vessels up to seven thousand tons, and the total cost of the line, lifting-docks, harbors, stations, shops, machinery and all other equipment was estimated at less than fifty millions.

In 1884 a treaty had been negotiated between the United States and Nicaragua for the construction of a canal by the former, to be owned by the two

states jointly. Whilst it was under consideration in the Senate the treaty was withdrawn by the President for the reason that it proposed a perpetual alliance with Nicaragua and, like the Hise treaty, imposed obligations on the United States for the protection of the former country which it was inadvisable to assume.

In April, 1887, Nicaragua granted a concession to A. G. Menocal for the construction of a ship canal from Greytown to Brito. Thus far the story has been a recital of plans, projects, and theories. When we take up the thread of it in a later chapter it will be to recount active operations.

RAILROAD AND CANAL.

The dotted line across the isthmus indicates the present course of the railroad; the heavy line shows the course of the Canal.

III.

PANAMA.

THE PANAMA RAILROAD.

The Terms of the Concession — The Great Difficulties of the Undertaking — Some Features of the Construction — The Course of the Line From Coast to Coast — Extraordinary Labor Difficulties — The Canal Company Secures the Railroad — A Monopolistic Agreement — The Assets of the Railroad and Their Value — Suggested Railroad and Steamship Traffic Reforms — A New Application of Our Protective Policy.

The great migration to the Pacific coast following the discovery of gold in "Forty-nine" acted as a strong incentive to the immediate establishment of an isthmian route by which the long and hazardous journey across the western territories of the United States might be avoided. In the last chapter a brief account was given of the enterprise conducted by the American, Atlantic and Pacific Ship Canal Company, which, although it never effected its original purpose of opening a waterway, afforded valuable service to the gold-seekers in the early fifties by maintaining a transportation line across Nicaragua.

At the outset of the gold movement thousands made their way to California by way of the Isthmus

of Panama. Steamships carried them from New York to the mouth of the Chagres. The journey thence to the Pacific coast, although no more than fifty miles by the trail, occupied from five to ten days and was accompanied by almost as much hardship and danger as in the days of Balboa. The emigrants were rowed or towed up the river by natives to a point near Cruces. The rest of the way to Panama was covered on foot or on mules. Women, when means would permit, were carried by *selleros.* These were native Indian porters, with a kind of chair strapped to their backs. There was, at that time, no regular steamship line between California and Panama. The travelers were often subjected to long and wearisome waits in the city. The old battery and the adjacent ramparts were favorite resorts of impatient watchers for a vessel from San Francisco, and their names and initials are cut in the stones by hundreds. On more than one occasion epidemic made serious inroads among them. General Grant, in his memoirs, tells us that he was with the Seventh United States Infantry at Panama in 1852, en route to California, when cholera broke out. Fifteen per cent of the regiment succumbed to the disease and more than five hundred emigrants died of it. Cholera is not one of the prevalent diseases of the Isthmus. An influx of foreigners to Panama has always been accompanied by an outbreak of yellow fever, to which the natives are immune.

View of La Boca, Panama Bay.

This transflux of travelers determined certain American capitalists to undertake the construction of a railroad across the Isthmus. A grant for the purpose had been made by the Government of New Granada to Mateo Kline, on behalf of a French syndicate, in 1847, but it had expired by default in 1848. In the following year, William Henry Aspinwall, John Lloyd Stephens, Henry Chauncy, of New York, and their associates incorporated under the name of the Panama Railroad Company.

THE TERMS OF THE CONCESSION.

Having declared all former similar concessions null and void, the Government of New Granada extended to this company the exclusive privilege of building a road and of operating it for a period of forty-nine years from the date of completion, which was to be not later than six years after the signing of the contract.

Subsequently this agreement was modified in important particulars, and in its present form entitles the company to "the use and possession of the railroad, the telegraph between Colon and Panama, the buildings, warehouses, and wharves belonging to the road, and in general all the dependencies and other works now in its possession necessary to the service and development of the enterprise for a period of ninety-nine years from the 16th day of August,

1867. At the expiration of this term the Government is to be substituted in all the rights of the company and is entitled to the immediate possession of the entire property. The Republic is bound to grant no privilege during this term to any other company or person to open any other railroad on the isthmus, nor without the consent of the company to open or work any maritime canal there to the west of a line drawn from Cape Tiburon, on the Atlantic, to Point Garachine, on the Pacific; nor to establish any such communication itself. But the company can not oppose the construction of a canal except directly along the route of its road, and the consent required is only to enable it to exact an equitable price for the privilege and as indemnification for the damages it may suffer by the competition of the canal. It is also stipulated that the company shall forfeit its privilege should it cede or transfer its rights to any foreign government."

THE GREAT DIFFICULTIES OF THE UNDERTAKING.

When the Republic of Colombia superseded the Government of New Granada (1867), new requirements were imposed upon the Railroad Company. It was compelled to pay to Colombia a quarter of a million dollars annually and to "transport free of charge the troops, chiefs, and officers, and their equipage, ammunition, armament, clothing, and all

similar effects that may belong to, are or may be destined for the immediate service of the Government of the Republic or the State of Panama, as also their officials in service or in commission, and those individuals who, with their families and baggage, may come to the country in the character of emigrants, and of new settlers with the permanent character of such, for account of the Government up to the number of 2,000 annually." This agreement was worked by the Colombian Government to the utmost, and the tremendous amount of "deadheading" with which the company was forced to put up cut into its profits seriously. Some idea of the extent to which this abuse was carried may be inferred from the fact that during the year 1903 the Company carried 4,663 first-class passengers who paid their fares and 11,098 passengers and 6,601 troops free. In addition a considerable amount of freight was transported gratis under the agreement.

The Panama Railroad Company, with characteristic American energy, attacked the difficult undertaking without delay. The engineering staff was on the ground in the autumn of 1849. "Their quarters were on board a sailing ship. They worked by day, waist deep in mud and slime, making surveys and cutting a trail, and slept at night on their floating home. Nothing but the indomitable will and push for which Americans are justly praised could have overcome the terrible difficulties that met them at every

step. The country was a howling wilderness, pestilential and death-dealing; the forests teemed with poisonous snakes and other equally unpleasant inhabitants; night was made hideous by the large, broad-chested, active mosquitoes of that part of the coast, who bite through clothing most successfully; the country produced absolutely nothing, and every mouthful of food had to come from New York. Despite these obstacles, that brave little band worked ahead, and kept on with their surveys. At the very outset they encountered the difficulty of finding a suitable location for the line traversing the quicksands and swamps between Colon of to-day and Gatun. It is reported that in some of the swamps the engineers under the late Colonel George M. Totten, and Mr. Trautwine, failed to find bottom at 180 feet. An embankment was created for the road by throwing in hundreds of cords of wood, rock, and more wood. This causeway, as it may be called, cost a fabulous sum of money; but at last it was completed and they floated their tracks, so to speak, over the swamps." *

Despite its ample resources and the unflagging application of its representatives in the field, the Company at the end of two years had completed only about one-half of the permanent way, or, to be more

* Five Years in Panama. Wolfred Nelson, M.D., New York, 1889.

exact, the twenty-three miles between Colon and Barbacoas. The transportation of passengers and baggage across the Isthmus was, however, in operation. The railway line was used as far as it was completed; canoes were employed upon the Chagres to Gorgona or Cruces; and the remainder of the journey was performed by road.

SOME FEATURES OF THE CONSTRUCTION.

At Paraiso, thirty-eight miles from the Atlantic, the line attains its greatest elevation, being 263 feet above the mean level of the ocean. Upon the western side of the divide the maximum grade is one in ninety; upon the Pacific slope it is a little more. Twenty-three miles of the road are level and twenty-five straight, but there are sharp curves in places. There are no fewer than one hundred and thirty-four culverts, drains, and bridges of ten feet and less, and as many as one hundred and seventy bridges from a twelve-foot span to the length of the Barbacoas. The line is a single one with five sidings, but it is the intention of the Canal Commission to convert it into a double-track road at an early date. The railroad is paralleled by a telegraph line. Of this, Pim, in his "Gateway to the Pacific," says: "There are twenty-six posts to the mile, constructed in the following manner: A scantling four inches square, of pitch-pine, is encased in cement, molded

in a cylindrical form, tapering toward the top, and sunk four feet in the ground. I was assured that when once dry these posts would last for ages. The cost of each was five dollars. They have the appearance of hewn stone and are quite an ornament along the line."

At the close of the year 1854 the construction had arrived at the divide. The Culebra pass afforded the greatest depression but it was practically two hundred and forty feet above sea level. The rails were carried over at this point and down the Pacific slope to Panama. On the 27th day of January, 1855, Colonel Totten went over the line upon the first locomotive to cross the American continent from ocean to ocean.

The utmost credit is due to the promoters of this great enterprise and to those who executed it. Aside from the important services the road has rendered to commerce during the past fifty years, its efficacy as a pioneer movement has been inestimable. The railroad opened the way over the Isthmus, stimulated the desire for a canal, and affords indispensable facilities for its consummation.

The cost of the road was considerably in excess of the original estimate. After its opening to through traffic, many improvements were carried out, including the expensive bridge at Barbacoas, and it is probable that the outlay in establishing the route exceeded eight million dollars.

From Colon the road runs almost due south by west for more than seven miles until it meets the Chagres at Gatun. Its general direction thereafter is south-easterly, along the valley of the river as far as San Pablo, the half-way point between the oceans.

THE FINE BRIDGE ACROSS THE CHAGRES.

Here the Chagres is spanned by the splendid Barbacoas, which word itself, in the native language, signifies a bridge. It is an iron structure over six hundred feet long, resting upon stone piers. It cost upwards of half a million dollars. During the dry season the river dwindles to a shallow, almost sluggish, stream, perhaps less than two hundred feet in width, but in the rains it becomes a torrent, sometimes far exceeding its normal bounds. Thus in 1878 the Chagres flooded its valley and rose to a height of fifteen feet over the railway. The earthquake of 1882 threw the bridge slightly out of alignment but apparently without seriously damaging it.

From San Pablo the road hugs the left bank of the river to Obispo, where it turns off suddenly at right angles to the stream. In the vicinity of Obispo is Cerro Gigante, the hill from whose summit Balboa is said to have gained his first view of the Pacific. There is no historic evidence on this point, and it seems more probable that if the exact spot could be ascertained it would be on one or the other of the

heights that flank the Culebra pass. At Paraiso, on the Pacific slope, the company's engineers had an experience that is inseparable from excavation works in this part of the world. A cut had been made forty feet in depth and the rails laid along its bottom, when the torrential rain swept the earth back and covered the track at a depth of twenty feet. A similar occurrence befell the Panama Canal Company more than once, affording a warning to the American engineers which they have carefully heeded.

EXTRAORDINARY LABOR DIFFICULTIES.

Reference has been made to some of the difficulties which were encountered in what Tomes ("Panama in 1885") characterises as the "almost superhuman" task of building the railroad across the Isthmus of Panama. Not the least of these were involved in the efforts to secure an adequate supply of labor. It was soon found that the natives could not be counted upon to any extent. The company concluded to import Chinamen and a ship landed eight hundred of them at Panama. They immediately began to fall sick and in a week's time upward of a hundred were prostrated. The interpreters attributed this to the deprivation of their accustomed opium. A quantity of the drug was distributed to them and had a marked effect for the

better, but, to quote Tomes, "a Maine opium law was soon promulgated on the score of the immorality of administering to so pernicious a habit, and without regard, it is hoped, to the expense, which, however, was no inconsiderable item, since the daily quota of each Chinese amounted to fifteen grains, at a cost of at least fifteen cents." Deprived of what from long habit had become a necessary stimulant and subjected to the depressing effect of the unaccustomed climate, the coolies lost all vigor and courage. In less than two months after their arrival there was hardly one of the original number fit to yield a pick or shovel. They gave themselves up to despair and sought death by whatever means came nearest to hand. Some sat on the shore and stoically awaited the rising tide, nor did they stir until the sea swallowed them. Some hanged themselves by their queues or used those appendages to strangle themselves. By various methods hundreds put an end to the misery of their existence. The remnant, fewer than two hundred, sick and useless, were shipped to Jamaica.

The next experiment of the Railroad Company was hardly less disastrous. A number of Irish laborers were imported at considerable expense, but, although the mortality amongst them was not so great as that experienced from the Chinese, it is said that the company failed to secure a single good day's labor from one of them. A great number

were buried on the Isthmus and the remainder were sent to New York, where most of them died from the effects of the fever contracted in the south.*

The road was finally completed with the labor of some three thousand men of mixed races, but chiefly negroes from Jamaica and East Indian coolies.

THE CANAL COMPANY SECURES THE RAILROAD.

The Panama Canal Company learned at an early stage in its operations that control of the railroad was essential to the success of its project. In the fall of 1879 the stock was offered to de Lesseps for $14,000,000, being at the rate of $200 each for 70,000 shares. This would appear to have been a very fair price when the worth of the line to the canal company is considered and the fact that its extremely profitable business, which had returned profits ranging from twelve to twenty-two per cent

* It should be stated that the late Colonel George M. Totten, chief engineer of the road, threw discredit upon these statements of excessive mortality which, however, have emanated from several apparently reliable authorities. Colonel Totten repeatedly stated that the number of men employed in the construction of the railroad at no time exceeded 7,000 and that the total deaths among the laborers during the five years of the operation were not in excess of 1,200. If we assume an average of 5,000 laborers per annum, probably an underestimate, we have a mortality of 48 per thousand, an incredibly low figure, when the conditions under which the road was built and the later experience of the French are considered.

per annum, was in prospect of practical annihilation on the completion of the waterway. De Lesseps, however, perhaps hoping to secure better terms, declined the proposition. The construction of the canal was commenced early in the following year but the operations were obstructed at every step by the Railroad Company, which instituted a systematic scheme of delay in the delivery of goods to the Canal Company. At length it was forced upon de Lesseps that the American corporation commanded the situation, and he decided to buy the company's shares. But in the meanwhile they had been steadily advancing, and when the transfer was effected the price had risen to $250 a share. Six-sevenths of the entire stock was sold to the Panama Canal Company,* the remainder being retained in American hands for the purpose of keeping the charter alive.

With the opening of the railroad a large traffic across the Isthmus sprang into existence and grew rapidly with the advance of time. The products of Asia and the countries upon the Pacific coast of America were carried from Panama to Colon, there to be distributed amongst steamships making the ports of Europe, Canada, the United States and the West Indies. Moving in the reverse direction,

* The company has been generally known in America by this name, but its corporate title was "La Compagnie Universelle du Canal Interoceanique de Panama."

goods from these countries reached, by the same transisthmian route, South and Central America and San Francisco. From the last named port reshipment was made to the Pacific islands and points on the Asian mainland. A number of steamship lines made regular calls at the terminal ports of the railroad. The line occupied a commanding position as the essential link in this chain of traffic, and took full advantage of the fact. Its charges were exorbitant and its profits enormous for many years. Its rates were based on, in general, fifty per cent of the through tariff. For instance, of the total cost of shipping goods from New York to Valparaiso, one half represented the charge of the Railroad Company for its share of the carriage. In some instances this policy of mulcting the shipper excessively resulted in loss of business. For many years the road carried enormous quantities of coffee to Europe. The through rate was about thirty dollars per ton. The Railroad Company received fifteen dollars and the two steamship companies that handled the goods divided a similar sum. In the early eighties a German line commenced to run to South and Central American ports by way of the Straits of Magellan. In a very short while this line had secured all the coffee shipments and much other freight that had previously been sent across the Isthmus.

However, the Railroad Company was not seri-

ously affected by these diversions, and in the course of time it entered into an agreement with the Pacific Steamship Company which created a condition in the nature of a monopoly, to which reference will be had again.

THE LONG CALMS ON THE PACIFIC COAST.

Tramp steamers often make the ports on either side of the Isthmus, and many sailing vessels put in at Colon. The latter are less frequent visitors at Panama on account of the calm that prevails on that coast. Such craft have been known to leave the latter port and return for fresh supplies after lying in the doldrums for weeks without being able to get away. There was the case of the British bark *Straun,* which cleared from Panama in May of the year 1884. After getting out of the Gulf she beat about between latitudes four and six for months and finally put back to port after being out one hundred and five days.

When the United States Government purchased the property of the Panama Canal Company it acquired 68,887 of the 70,000 shares of the Railroad Company. Since then the Isthmian Canal Commission has bought a few more shares in the open market, and stands ready to pay par for the remainder. The offer is a fair one, considering that with the completion of the canal the property will deteriorate

greatly in value. The holders of the minority stock do not, however, evince any eagerness to part with their holdings. They know that the Government is anxious to secure entire possession, and moreover the business of the line has increased and will continue to do so during the canal operations. The situation places the Government in something of a dilemma. So long as any stock is outstanding in the hands of private individuals the Commission may not neglect the interests of the minority shareholders and must conduct the line on strictly business principles and hold commercial considerations paramount to the convenience of the canal construction. Secretary Taft, in his letter of transmission to the President, accompanying the annual report of the Isthmian Canal Commission for 1904, suggests two ways of solving the difficulty and securing the desideratum of having the road "wholly under the control and use of the Government of the United States." The first suggestion is to condemn the stock and pay a reasonable price to the holders. The Secretary thinks "this method is a possible one and that the condemnation proceedings under a statute of the United States might be pursued in the State of New York, which incorporated the company and where its chief office now is. It would require special legislation by Congress." The second means suggested is "to use the power that the United States has" (by reason of its majority in-

terest) "to elect directors who will lease the railroad to the Isthmian Canal Commission at a rental which will involve the payment of the fixed charges upon the railroad and a reasonable dividend upon all the stock. Of course the dividend earned upon the stock belonging to the United States need not be paid. In this way the Isthmian Canal Company will become the lessee of the railroad, and, provided it does not injure the property and discharges the obligations of the original company under its franchise, can use the railroad for the purposes of constructing the canal without embarrassment." *

THE ASSETS OF THE RAILROAD AND THEIR VALUE.

The property of the Railroad Company transferred to the United States Government consists of about forty-eight miles of single track with twenty-six miles of sidings; thirty-five locomotives, thirty passenger cars, more than nine hundred freight cars and a quantity of miscellaneous rolling stock. The equipment, like everything else that came from the hands of the French company, was in a condition of unnecessary deterioration. The railroad company owns repair shops, wharves and buildings at both Panama and Colon, and almost the entire island of Manzanillo, upon which the latter city stands, is its

*The United States Government now owns all the stock of the Panama Railroad. The bonds are mostly held by private individuals.

property. It holds large parcels of real estate along the line, aside from the land actually occupied by the road, and has, with the Pacific Mail Steamship Company, an undivided half interest in the islands of Naos, Culebra, Perico, and Flamenco, all in Panama Bay. It is also the proprietor of three steamships having an average tonnage of about twenty-seven thousand. The entire property, "cost of road, real estate, and equipment," including the steamships, tugs, lighters, etc., is carried on the books at what would seem to be the conservative valuation of a little over twelve millions and a half. The company's balances have not varied greatly in the past ten years, and the figures for 1903 are very near an average. The gross receipts were: railroad, $1,743,636; steamers, $920,414; total, $2,644,051. Operating expenses, railroad, $886,482; steamers, $873,885; total, $1,760,337. Earnings over expenses, $903,713.

As soon as the Government assumed charge of the railroad, complaints of the traffic monopoly were made by shippers who had been without means of redress under the old conditions. The justice of these complaints was fully recognized by the authorities. General Davis, the first governor of the Canal Zone, severely criticised the management of the road, and Secretary Taft, in the report to which reference has already been made, says: " . . . Whatever may have justified the rates charged by

View of the Chagres River and Labor Camp.

the railroad company, the salaries paid by it, and the character of its corporate organization, and the expenses of the office in New York, certainly for the purposes and under the control of the United States, radical changes must be made."

SUGGESTED RAILROAD AND STEAMSHIP TRAFFIC REFORMS.

A contract existed between the railroad company and the Pacific Mail Steamship Company, which secured to the latter concern the exclusive privilege of issuing through bills of lading on freight from San Francisco to New York. Mr. Taft expressed the opinion that this contract was "invalid under the laws of Colombia and the laws of Panama." The Panama Railroad Company ran three cargo steamers on the Atlantic side, between New York and Colon, and would recognize no through bills of lading except those issued from its office in New York. Goods shipped across the Isthmus by any other line were charged the heavy local freight rates in force between Panama and Colon. This arrangement, together with its control of the docking facilities at Colon, most effectually enabled the company to shut out any competition in the Atlantic carrying trade.

Early in 1905, Joseph W. Bristow was commissioned to investigate the situation under consideration. After an examination extending over several

months he substantiated the foregoing facts and made the following recommendations: That the road should be continued as a commercial line, that it should be double-tracked, equipped with modern rolling stock, and supplied with additional wharves and other improvements; that the rates for through freight should be made as low as the cost of the service and provision for a fair dividend will permit; that the steamship line maintained by the road between Colon and New York should be continued by the Government; that the exclusive contracts with the Pacific Mail Steamship Company and the two South American west coast lines should be cancelled "and the ports of Colon and Panama be opened to the use of all steamship lines on equal terms;" that in case a new steamship line be not established within reasonable time by private capital between Colon and the Gulf ports, the Railroad Company should establish and maintain such a line (It is cheaper and more convenient to move the products of the Mississippi Valley by way of these ports than through New York); that in the event of the Pacific Mail Steamship Company discontinuing its service between San Francisco and Panama some other private corporation should be encouraged to take its place, but failing this, the Panama Railroad Company should run a line of steamers over the route.

It will be seen that the report contemplates a considerable extension of the Government's commercial

operations, but only as alternative measures to be resorted to in case the desired objects can not be attained through private enterprise. Mr. Bristow recommends favoring American ships in traffic relations as far as may be consistent with treaty obligations, but, upon the theory that the railroad is performing the functions of a canal, he does not deem it practicable to discriminate to the advantage of American bottoms at the ports of Panama and Colon.

The report met with the approval of the Government, and its recommendations in general will be carried out. As a first step in that direction the exclusive contract with the Pacific Mail Company was cancelled, June the 12th, 1905.

A NEW APPLICATION OF OUR PROTECTIVE POLICY.

At the outset of the Government's operations in connection with the railroad and canal a serious question arose which will demand the attention of the next Congress and may have an important bearing upon general tariff legislation. When the Commission was called upon to purchase supplies, the engineers in charge of the works drew its attention to the fact a great deal of the necessary material could be bought in foreign markets at a substantially lower figure than the lowest quotations of American bidders. The significant point was that these varia-

tions obtained where American-manufactured goods only were under consideration. For instance, steel rails were needed for the railroad. The fixed price of these rails in the United States was $28 per ton at the rolling mill. Freight charges to the Isthmus would increase the figures to $33. At the same time the Steel Trust was selling identically similar goods in foreign countries all over the world at $20 and $22 and paying the freight, amounting to as much as $8 per ton in some cases. In other words, a Mexican railroad might secure for $16 rails that the Panama Railroad, simply because it was an American corporation, was required to pay $33 for. It was found that from 30 to 40 per cent excess over foreign prices must be paid for the steel cars used in excavating. Two ships were required, and inquiry established the fact that one-half of the outlay involved, ($750,000), could be saved by purchasing from British owners. Many other requisitions could only be filled at the price of an exorbitant profit to different trusts.

President Roosevelt, who has been invested by Congress with full authority for the construction of the canal, and upon whom full responsibility must necessarily fall, feels bound to conduct the operation with all reasonable economy, particularly at a time when the Government's expenditures are so largely in excess of its revenues as to suggest the imposition of additional taxes upon the people. The President prefers that the material used in the construction of

the canal should be purchased from American manufacturers, but he insists that the United States Government should not be required to pay higher prices than those at which the same manufacturers are glad to sell the same goods to foreign buyers. Mr. Roosevelt's decision that the Panama Canal Commission shall buy material and supplies where they can be obtained at the lowest price is likely to have far-reaching effect. It will lead to a discussion of the tariff by Congress, which, unless their supporters in the Senate prove strong enough to withstand it, will probably result in legislation adverse to the trusts.

It is hardly necessary to state that as an adjunct to the canal operation the railroad is of the highest importance — indeed, it is a *sine qua non.* With the completion of the waterway, the road will lapse into the condition of a mere local line between Colon and Panama. It should, nevertheless, continue to be a valuable property in the hands of either the Government or a private corporation. As a means of transporting men and material employed in the operation of the completed canal it will always be of service. It is probable that a considerable amount of freight will be reshipped even after the canal is opened. Many voyagers will leave vessels at the point of entering the canal in order to avoid what will generally be an unpleasant passage and secure the opportunity of spending a few hours in Panama by

making the transit by rail. Both the terminal ports, but especially Panama, must grow rapidly under the influences of future traffic and the local business of the railroad will be proportionately increased.

IV.

PANAMA.

THE ISTHMIAN COUNTRY.

Political Changes in Panama and Columbia — The Recent Revolution in Panama — A Comic Opera Coup d' état — The American Part in the Affair — United States Marines Are Landed — Nerve a More Potent Factor than Numbers — The President's Denial of Official Complicity — Columbia's Tardy Appreciation of Her Interests — The Ancient Graves of Chiriqui — Curious Ornaments of a By-gone Race — The Mystic Frog of the Early Indians — The Mineral Resources of Panama — The Famous Pearl Islands of Panama Bay — Climatic Conditions on the Isthmus.

During recent years the ribbon of land that joins the continents of North and South America has loomed large in the public eye.

Since the days of Greece's glory no such small strip of soil as the Isthmus of Panama has gained equal distinction. It has been the scene of stirring adventure and the site of the wealthiest city in the world. It has been the subject of epoch-making diplomacy and a sphere for political disturbances. It is the seat of the greatest engineering enterprise in history; an enterprise which is destined to largely revolutionize the commerce of the earth and, more than

any other modern factor, to influence the fortunes of nations.

In the second decade of the sixteenth century Angel Saavedra mooted the idea of a canal through this narrow neck of inter-ocean territority. Since that time the thought could not be banished from the minds of men though a King of Spain decreed death to any who should voice it. For two hundred years and more plans and projects for the great waterway have been advanced. The first attempt to construct it ended in a cataclysmal failure. In these early years of the twentieth century the opening of a passage is at length assured and it will be available to the traffic of the world almost, perhaps exactly, four hundred years from the discovery of the Pacific.

THE ISTHMUS OF PANAMA.

The neck of land separating the two great oceans of the globe, which is called the Isthmus of Panama, forms the southern termination of the great American isthmus extending north to Mexico. This strip of land curving about four hundred and seventy miles from west to east has commonly been styled the Isthmus of Darien, but that name is more properly applied to the section of country between the Gulfs of Uraba and San Miguel. The Isthmus of Panama is traversed along its entire length by the

Cordillera de Baudo, separated from the Andes by the Valley of the Atrato which marks the northern limit of South America. Erroneous impressions are apt to be created by the usual practice of studying geography with the aid of the ordinary flat maps, which have the effect of exaggerating the size of countries in high latitudes and diminishing the equatorial areas. One thousand miles in latitude 60 degrees occupies upon the ordinary map twice as much space as does one thousand miles along the equator. It is a revelation to many a well-informed person to learn that South America is very nearly as large as North America. For the study of the Panama Canal in its relations to the rest of the world the use of a globe, or a map on the polyconic projection is recommended. Another point worth noticing in this connection is that the most pronounced diversion from the general north and south trend of the Americas is found in the Isthmus of Panama, which takes a lateral direction east and west and throws the southern continent, so to speak, to the east of the northern, so that a line dropt due south from New York would pass through the Pacific Ocean off the coast of Chile.

In looking at a map of the western hemisphere we are accustomed to finding the Atlantic Ocean to the east or on the right hand. For this reason a sectional map of the Canal region is likely to be a little confusing at first glance. It will show the Pacific on the right and the Atlantic on the opposite

side of the page. This is due to the fact that the Isthmus makes a northerly loop in the portion containing the Canal Zone, and Panama is actually east of Colon, from which port the Canal will take a south-easterly direction to its Pacific terminus. A line from Buffalo continued south would bisect the Canal and leave Panama on the right and Colon on the left.

The writer finds an excuse for these explanations in the knowledge that many intelligent persons have been puzzled by the unfamiliar geographical conditions involved in an examination of the Canal project and related subjects.

POLITICAL CHANGES IN PANAMA AND COLUMBIA.

Having secured their independence from Spain, the provinces of Venezuela, Ecuador, Colombia, and Panama formed a republican federation. Subsequently, the two first-named seceded, and Panama with Colombia established the United Sovereign States of New Granada. Although each of the states combined in this political union exercised sovereign powers, the paramount authority in the territory became gradually centralized at Bogota. In 1861, against the wishes of the leading citizens of Panama, the United States of Colombia were organized with a new constitution conferring greater powers on the government at Bogota. Twenty-five years later, after

a civil war in which many lives were lost, Colombia succeeded in establishing the republic which took her name. By this measure Panama lapsed to the condition of a mere department with a governor appointed by the Colombian president and vested with little independent authority. The Panamans, whilst forced to submit to this degradation, have always protested against it and have consistently declared their right to the position of a constitutional state. The government of Panama by the corrupt Colombian politicians had always been bad, and the people of the Isthmus had entertained the design of independence for years before America opened negotiations for the Canal and, indeed, had enjoyed it for three years following 1857.

THE RECENT REVOLUTION IN PANAMA.

Panama threw off the yoke of Colombia at an extremely opportune time as regards the plans of the United States for the construction of the Isthmian Canal. The coincidence of the event was the only basis for the utter nonsense written in this country upon the subject at the time. Even recently certain papers have published a silly story by a syndicate writer which purports to give the "inside" history of the rebellion. There is absolutely no ground for the accusation that the American authorities instigated the *coup* which gave independence to the Isth-

mus, but, on the contrary, sufficient evidence that, although they may have had some inkling of the attempt before its occurrence, they were entirely free from participation in it. The suspected representatives of our Government have denied that any American official instigated or assisted in the revolt. In this they are borne out by the statements of the leading Panaman revolutionists and by Doctor Herran, the Colombian Minister to Washington at the time.

The Hay-Herran Treaty was negotiated at Washington in 1903 between the representatives of the Governments of the United States and the Republic of Colombia. Its purpose was to secure to the former state the privilege of making a canal through the Isthmus of Panama, and amongst its provisions was one guaranteeing to Colombia the payment of ten millions of dollars upon the completion of the convention. The national legislature of the latter country, moved it is believed by the hope of inducing us to pay a higher price, failed to ratify the treaty.

A COMIC OPERA COUP D'ÉTAT.

The Panamans are much more astute than is generally supposed. They had realized fully the enormous advantages that would accrue to their country from the operation of the Canal by America, and when the opportunity seemed to be in danger of destruction by the action of the Colombian politicians

the leading men in Panama who, as has been said, have harbored thoughts of independence for years, determined to take matters into their own hands. No doubt they calculated, as they reasonably might, upon the United States acknowledging them as soon as they had knocked off the shackles. The revolution was bloodless and savoured of *opéra bouffe* in the absurdity of its details. The Government of Bogota learned of the plot before it was put into execution and despatched several hundreds of the ragamuffins that composed its "army" to Panama under Generals Tobal and Amaya, with orders to arrest the conspirators and carry them to the capital. When the detachment arrived at Colon the generals hurried forward over the railroad with their warrants and were promptly placed in confinement by the revolutionary leaders.

Meanwhile, Colonel Shaler, the Superintendent of the Panama Railroad, unquestionably placed impediments in the way of the further progress of the troops. It must be remembered, however, that Colonel Shaler, although an American, was not an official and acted as the representative of the corporation which was interested in the sale of the canal property to the United States, for the Panama Canal Company owned the railway.

The sympathy of the American Government and people was unquestionably with the Panamans, but they received no official aid from this country.

Marines were landed from an American gunboat and two days later the Colombian troops took ship for Cartagena. Panama immediately declared itself an independent republic and was recognized by the United States without delay.

THE AMERICAN PART IN THE AFFAIR.

There is reason to believe that the Colombian soldiers were bribed — at the rate of about five dollars apiece — by friends of Panama, but the statement that the money was distributed or handled by an officer of the American Navy is a gross and stupid libel. The presence of the marines was without doubt a decisive factor in the accomplishment of the revolution, but that it was not premeditated and had no other purpose than the protection of American lives is proved by the following official report of the officer commanding the *Nashville:*

"U. S. S. *Nashville,* Third Rate.
"Colon, U. S. Colombia, November 5, 1903.

"Sir: Pending a complete report of the occurrences of the last three days in Colon, Colombia, I most respectfully invite the Department's attention to those of the date of Wednesday, November 4, which amounted to practically the making of war against the United States by the officer in command of the Colombian troops in Colon. At 1 o'clock p. m.

on that date I was summoned on shore by a preconcerted signal, and on landing met the United States consul, vice-consul, and Colonel Shaler, the general superintendent of the Panama Railroad.

"The consul informed me that he had received notice from the officer commanding the Colombian troops, Colonel Torres, through the prefect of Colon, to the effect that if the Colombian officers, Generals Tobal and Amaya, who had been seized in Panama on the evening of November 3, by the independents, and held as prisoners, were not released by 2 o'clock p. m., he, Torres, would open fire on the town of Colon and kill every United States citizen in the place, and my advice and action were requested. I advised that all the United States citizens should take refuge in the shed of the Panama Railroad Company, a stone building susceptible of being put into good state for defense, and that I would immediately land such body of men, with extra arms for arming the citizens, as the complement of the ship would permit.

UNITED STATES MARINES ARE LANDED.

"This was agreed to, and I immediately returned on board, arriving at 1:15 p. m. The order for landing was immediately given, and at 1:30 p. m. the boats left the ship with a party of forty-two men under the command of Lieutenant-Commander H.

M. Witzel, with Midshipman J. P. Jackson as second in command. Time being pressing, I gave verbal orders to Mr. Witzel to take the building referred to above, to put it into the best state of defense possible, and protect the lives of the citizens assembled there — not firing unless fired upon. The women and children took refuge on the German steamer *Marcomania* and the Panama Railroad steamer *City of Washington,* both ready to haul out from dock if necessary.

"The *Nashville* got under way and patrolled along the water-front close in and ready to use either small arm or shrapnel fire. The Colombians surrounded the building of the railroad company almost immediately after we had taken possession, and for about one and a half hours their attitude was most threatening, it being seemingly their purpose to provoke an attack. Happily our men were cool and steady, and while the tension was very great no shot was fired.

"At about 3:15 p. m. Colonel Torres came into the building for an interview and expressed himself as most friendly to the Americans, claiming that the whole affair was a misapprehension, and that he would like to send the *alcalde* of Colon to Panama to see General Tobal and have him direct the discontinuance of the show of force. A special train was furnished and safe conduct guaranteed. At about 5:30 p. m. Colonel Torres made the proposi-

STEAM-SHOVELS WORKING AT CULEBRA.

tion of withdrawing his troops to Monkey Hill if I would withdraw the *Nashville's* force and leave the town in possession of the police until the return of the *alcalde* on the morning of the 5th.

THE NERVE OF AMERICAN MARINES PREVENTS A CONFLICT WITH COLOMBIA.

"After an interview with the United States consul and Colonel Shaler as to the probability of good faith in the matter, I decided to accept the proposition and brought my men on board, the disparity in numbers between my force and that of the Colombians — nearly ten to one — making me desirous of avoiding a conflict so long as the object in view — the protection of American citizens — was not imperiled.

"I am positive that the determined attitude of our men, their coolness and evident intention of standing their ground, had a most salutary and decisive effect on the immediate situation, and was the initial step in the ultimate abandoning of Colon by these troops and their return to Cartagena the following day. Lieutenant-Commander Witzel is entitled to much praise for his admirable work in command on the spot.

"I feel that I can not sufficiently represent to the Department the grossness of this outrage and the

insult to our dignity, even apart from the savagery of the threat.

"Very respectfully,

"JOHN HUBBARD,

"Commander, United States Navy, Commanding.

"The Secretary of the Navy, Navy Department, Washington, D. C."

In his more detailed report Commander Hubbard stated: "I beg to assure the Department that I had no part whatever in the negotiations that were carried on between Colonel Torres and the representatives of the provisional government; that I landed an armed force only when the lives of American citizens were threatened, and withdrew this force as soon as there seemed to be no grounds for further apprehension of injury to American lives or property; that I relanded an armed force because of the failure of Colonel Torres to carry out his agreement to withdraw and announced intention of returning; and that my attitude throughout was strictly neutral as between the two parties, my only purpose being to protect the lives and property of American citizens and to preserve the free and uninterrupted transit of the isthmus."

THE PRESIDENT'S DENIAL OF OFFICIAL COMPLICITY.

President Roosevelt, referring to the foregoing reports, says: "This plain official account of the oc-

currences of November 4 shows that instead of there having been too much prevision by the American Government for the maintenance of order and the protection of life and property on the isthmus, the orders for the movement of the American warships had been too long delayed: so long, in fact, that there were but forty-two marines and sailors available to land and protect the lives of American men and women. . . . At Panama, when the revolution broke out, there was no American man-of-war and no American troops or sailors. At Colon Commander Hubbard acted with entire impartiality toward both sides, preventing any movement, whether by the Colombians or the Panamanians, which would tend to produce bloodshed. On November 9 he prevented a body of the revolutionists from landing at Colon."

In his message to Congress the President made the following reference to the treaty and the complications which grew out of it: "During all the years of negotiation and discussion that preceded the conclusion of the Hay-Herran treaty, Colombia never intimated that the requirement by the United States of control over the canal strip would render unattainable the construction of a canal by way of the Isthmus of Panama; nor were we advised, during the months when legislation of 1902 was pending before the Congress, that the terms which it embodied would render negotiations with Colombia im-

practicable. It is plain that no nation could construct and guarantee the neutrality of the canal with a less degree of control than was stipulated for in the Hay-Herran treaty. A refusal to grant such degree of control was necessarily a refusal to make any practicable treaty at all. Such refusal therefore squarely raised the question whether Colombia was entitled to bar the transit of the world's traffic across the isthmus. . . . Colombia, after having rejected the treaty in spite of our protests and warnings when it was in her power to accept it, has since shown the utmost eagerness to accept the same treaty if only the *status quo* could be restored. One of the men standing highest in the official circles of Colombia on November 6 addressed the American minister at Bogota, saying that if the Government of the United States would land troops to preserve Colombian sovereignty and the transit, the Colombian Government would 'declare martial law, and, by virtue of vested constitutional authority, when public order is disturbed, (would) approve by decree the ratification of the canal treaty as signed; or, if the Government of the United States prefers, (would) call an extra session of the Congress — with new and friendly members — next May to approve the treaty.'

"Having these facts in view, there is no shadow of a question that the Government of the United States proposed a treaty that was not only just, but

generous to Colombia, which our people regarded as erring, if at all, on the side of overgenerosity, which was hailed with delight by the people of the immediate locality through which the canal was to pass, who were most concerned as to the new order of things, and which the Colombian authorities now recognize as being so good that they are willing to promise its unconditional ratification if only we will desert those who have shown themselves our friends and restore to those who have shown themselves unfriendly the power to undo what they did. I pass by the question as to what assurance we have that they would now keep their pledge and not again refuse to ratify the treaty if they had the power; for, of course, I will not for one moment discuss the possibility of the United States committing an act of such baseness as to abandon the new Republic of Panama."

DESCRIPTION OF THE ISTHMUS OF PANAMA.

The recognition of the independence of Panama by the United States was followed by a treaty between the two countries which will be referred to in a succeeding chapter.

The physical features of the Isthmus of Panama are very diversified. The center of the country is occupied by mountains and hills. In some parts these elevations extend to the coast, but usually they

are flanked by alluvial plains or gently rolling country. This again is fringed by a strip of costal swamp covered with mangroves. Heavy forest and dense jungle clothe the mountain districts. The growth is so strong and rapid that the railroad company has to maintain a constant fight against its inroads. If not checked it would in six months bury the line. The Chagres is the principal river in every respect, but there are a number of smaller streams.

The territory of the Republic of Panama is divided into provinces and these into municipal districts. The canal route traverses two of these provinces — those of Colon and Panama. Their prosperity is assured by the American enterprise now in process of development.

THE INHOSPITABLE SAN BLAS COUNTRY.

The province of Darien is not a promising region. It is largely made up of mountainous wilderness and impassable swamps. Rumor has persistently credited the San Blas district with rich gold deposits, but verification is rendered difficult by the unfriendly attitude of the Indians there, who have always displayed an unconquerable objection to the presence of white men. The San Blas Indians occasionally visit Panama on trading or marketing excursions, but they are reticent about their country and their affairs and decidedly averse to any but the most tem-

porary relations with foreigners. The provinces of Chiriqui and Veragua support industries of considerable importance and appear to be capable of much greater development under favorable conditions. David, the capital of Chiriqui, occupies an extremely picturesque site upon a well-wooded coast. Behind the town stretches a fertile savanna backed by a range of mountains from two to three thousand feet in height. It is one of those quaint old settlements with which the traveler in Spanish-America becomes familiar, but he never tires of the air of restful simplicity that pervades them. The houses, generally one story in height, are square whitewashed structures with roofs of red tile and front verandahs. The inhabitants are hospitable, contented and inclined to take life easily. Several of them are well-to-do and not a few highly cultured.

THE ANCIENT GRAVES OF CHIRIQUI.

Chiriqui became suddenly famous several years ago on account of the interesting relics that were unearthed there from the *guacas,* or graves, of the ancient inhabitants. A great number of these treasures were found in the district of David. "History is silent about the people who are buried in thousands there. The discovery of these old cemeteries came about in this wise: Many, many years ago in cutting a trench through a peaceful forest to drain

off water, the Indian diggers came across an image of gold. Great was their surprise and the *execrable sedd'ore,* or 'the cursed thirst of gold,' settled upon that primitive people like a nightmare. They kept on digging, and unearthed quantities of golden ornaments and images of various kinds. Soon hundreds were digging in the forest, and it has been estimated that gold ornaments were uncovered to a value exceeding $400,000 in a space of five or six years. They were sold for their weight, or value in coin, and went into the melting pot. Later, some archæologists took an interest in the matter, and some systematic work was done, they directing and the natives doing the digging. It would seem that in the majority of cases the graves first were dug, their sides lined with pieces of stone, and then cross pieces were laid over these. Inside, the pottery was placed, together with ornaments of gold, cooking utensils, etc. The graves of the poorer class contained nothing but cooking utensils and no gold ornaments were found in them.

A native locates a grave by tapping the earth as he walks along. As soon as he gets a hollow sound familiar to his expert ear he commences digging and digs down. The contents are stone implements, pottery implements, ornaments and pure gold, and ornaments of gold gilt, a species of pinchbeck, called by the natives here *tumbago.* There are also ornaments in copper, and a few bone instruments.

"There are a number of small idols in stone, varying from nine to eighteen inches high. There is also a species of grinding stone, on which they evidently ground their corn, or its equivalent. The better class of these grinding stones were from eighteen to twenty-four inches in length, and from twelve to fifteen inches in width. I am now speaking of some of the largest. They were concave on top, and in the graves were found stone rollers fitting the upper surface. Generally they were made to represent some animal.

CURIOUS IMPLEMENTS OF A BY-GONE RACE.

There were some with tiger-shaped heads and four legs. The tail generally folded around and rested on the left hind leg. A commoner type of grinding stone resembled a low stool of stone without any ornamentation. In the graves were found an endless variety of stone chisels and stone hatchets. Some of these chisels and hatchets were beautifully proportioned, presenting various planes and surfaces for examination, and their edges in many instances were sharp even after having been exposed for long centuries to the effects of that humid soil. These were the implements with which the people did all their carving.

"In the pottery implements the variety was almost endless, not only suggesting considerable ingenuity, but also some knowledge of the anatomy of

the human body. Between many of these pieces of pottery and the male angels on the doors of La Merced, at Panama, there was a striking analogy. . . . Roughly classifying the pottery utensils, they were of two kinds, glazed and unglazed, and many of the markings on them had been made in black and red pigments. Many of the borders, while crude, were very suggestive. There was a series of gods, little squat figures with triangular faces; nearly all of which had been glazed and were ornamental. Their pectoral development was remarkable. It is supposed that they were a kind of idol. . . . Then there were rattles of ingenious construction, with which they soothed the gentle baby in early days. There was a series of whistles (it is supposed that they were bird calls) producing all sorts of notes, from a full rich sound to a gentle twitter. . . .

THE MYSTIC FROG OF THE EARLY INDIANS.

"Among the gold ornaments found in the *guacas* at Chiriqui were many frogs. The frog seems to have been a favorite type of ornament with those early races. The largest frog of pure gold uncovered there weighed eighteen ounces. . . . Another thing that seemed very strange to me was a kind of bell. It was of gold, and an exact counterpart of the old-time sleigh-bells, or those with a slot. It had a handle and within were little pieces of metal, and these

little bells, when shaken, emitted quite a musical sound. . . . Among the *tumbago* ornaments the majority represented birds or frogs. From a careful examination of a number of them the body seemed to be made of copper covered with a film of gold. How it was put on I am unable to say, but certainly gold it was. . . . I saw another specimen which caused me a deal of speculation. It evidently was intended for the figure of a king. It was in bronze, and that surprised me greatly, because the art of casting in bronze is deemed an art to this day." *

THE MINERAL RESOURCES OF PANAMA.

It is very probable that with the exploitation that is likely to follow the opening of the Canal, the Isthmus will prove to have rich and extensive mineral resources. Gold, copper, manganese, and coal are known to exist in different parts, but the greater portion of the country is yet to be subjected to geological surveys. When the waterway comes into use a great market for coal will be established at Panama and the demand will doubtless lead to the operation of local mines. The island of Muerto, near David, is said to be almost a solid mass of coal covered with a stratum of clay. As early as 1851 the geologists, Whiting and Schuman, made a report on this deposit

* Wolfred Nelson.

which was published in London. Here would seem to be a favorable opportunity for American capital and enterprise.

There are large areas of good grazing ground in the western provinces, and the industry has been pursued to some extent. When the Canal is in use there will be a ready and profitable market for meat at Panama and cattle raising should become one of the chief industries of this section.

The country about the Chiriqui Bay already has a large and flourishing fruit trade. The entire region in the neighborhood of the Costa Rica border is exceeding rich — as rich as any in the tropics, perhaps. It might be developed with comparative ease. It has a pleasant and salubrious climate. The people are genial and hospitable; well-disposed towards Americans and eager for improvement.

THE FAMOUS PEARL ISLANDS OF PANAMA BAY.

The famous Pearl Islands lie in the Gulf about forty miles off the city of Panama. By the Spaniards they were called the King's Archipelago. The pearl fisheries are of very ancient origin. Balboa secured a number of the gems from the Indians and was told by them that the pearl oyster had been sought in these waters during uncountable ages. At one time these fisheries were probably as rich as any in the world, but reckless methods injured them, and

whilst they are still worked in a desultory fashion, it may be said that the old beds are practically exhausted.

The pearls of Panama have always been noted for their size. It is said that specimens as large as filberts have been found. They are very lustrous and have a silvery sheen, differing from the creamy shade of the pearl of Ceylon.

The native Panamans are a more attractive people than one would be led to suppose from the accounts of travelers who have only come in contact with the lower classes in the city of Panama who are a mixed and far from representative lot.

It has long been a practice with the well-to-do creole families to send their children of both sexes to the best colleges of Europe and America. Consequently the upper class is distinguished by refinement and culture as well as many natural qualities of an admirable character. They entertain the strongest feelings of admiration and respect for the American people, and, if we may judge from recent experiences, our relations to the Panamans will continue without difficulty or friction.

The disbandment of the army by President Amador was effected with little trouble because of the kindly intervention of the American minister, whose advice was accepted by both sides in a friendly spirit. It is doubtful if any other South American Republic could attempt the retirement of the entire military

force, no matter how weak, without precipitating a revolution.

The *rancheros* of the country districts are peacefully inclined and contented with their simple pastoral life. They live in huts of the simplest construction and till a few acres of ground. Their wants are very few and easily supplied. The condition of the peon will be improved with the general prosperity that is in store for the Isthmus.

CLIMATIC CONDITIONS ON THE ISTHMUS.

Except upon the coasts the climate of the Isthmus is not worse than that of the average tropical region and in some parts of the territory it is quite healthful and pleasant. Hundreds of Americans have been employed by the railroad and many of them have enjoyed excellent health during residences extending from ten to twenty years. The average temperature is about eighty degrees and there is generally a refreshing breeze from the north. The humidity in the rainy season is great and its effect very enervating to natives of higher latitudes. There are two seasons. The wet season commences about the middle of April and lasts for eight months. The dry season from the middle of December is generally considered healthy even in the canal region. During this period the sky is a cloudless blue by day and at night the moon and stars are sublime.

V.

PANAMA.

COLON AND PANAMA.

Porto Bello — Colon an Unattractive City — The Departed Glory of Panama Viejo — Panama's Wealth Attracts the Buccaneers — Morgan's Expedition to Isthmus of Darien — The Pirates Attack the City of Panama — The City Is Sacked and Put to the Torch — New Panama Built With Regard to Defense — The Houses and Churches Convertible Into Forts — The Interesting Church of Modern Panama — The Famous Flat Arch of St. Dominic — The Dead Are Temporary Tenants of Their Graves — In Spanish-America Graft Extends to the Grave — American Authority in The Panaman Republic — Panama Enjoys the Boon of Good Water.

In the days when Spain maintained a great trade route across the Isthmus, the Atlantic terminus was Porto Bello, about twenty miles east of the mouth of the Canal. A cluster of Indian shacks upon a low beach now marks the place where the Spanish galleons were wont to land their cargoes of merchandise and take on board the pearls and precious metals consigned to the king's treasury. The ruins of the old city are shut in by heavy woods and lost in a tangle of dense undergrowth.

The construction of the railway gave birth to the

modern port. The Americans called it Aspinwall, after one of the chief promoters. By the French it was named Colon. The city is built upon the Island of Manzanillo, a sand-covered coraline formation, three-quarters of a mile in length and not more than six hundred yards broad. It stands a very few feet above the ocean at high tide and is connected with the mainland by the railway embankment. The original town was anything but a pleasant or healthy place of residence. The railroad buildings, dwellings, laborers' quarters, and shops, mostly of wood, were scattered about without any particular system or order. The center of the island was occupied by an almost stagnant lagoon, creating a most undesirable condition.

During the disturbances incident to the revolution of 1885, Colon was completely destroyed by fire. It was reconstructed with somewhat more regard for convenience and sanitation, but still leaving much to be desired in both respects.

COLON AN UNATTRACTIVE CITY.

The Colon of today is a straggling, unattractive city with some redeeming features, however, and a promise of more in the near future. The railroad company occupies the greater part of the water-front with its various buildings, including wharves and docks. Parallel with these is the main street, com-

Ruins of St. Augustine, Old Panama.

posed almost entirely of frame buildings. There are some good shops and a number of conscienceless dealers in spurious curios who, together with the enterprising money changers, reap a royal harvest from unsophisticated travelers. From the moment of landing the stranger is beset by a howling crowd of nondescripts who contend with one another for the privilege of fleecing him. His baggage is distributed amongst as many different individuals as possible, and upon his arrival at the hotel he is called upon to pay each one an exorbitant fee for his service, although it may have consisted in carrying a newspaper only. Before the American advent there was no escape from this imposition. If a victim refused to be mulcted he was haled before a magistrate who invariably supported the extortioners. In those days a man dared not ask a native the name of a street unless he was prepared to pay for the information. This system of bleeding the helpless foreigner is now confined within the bounds of semi-decency and an American, at least, is treated with a show of honesty.

COLON ALWAYS AN UNSANITARY TOWN.

Along the beach to the east of the town is the foreign quarter, containing some comfortable residences, an Episcopal church built of stone, and a tolerable hotel. On the west side, fronting the

ocean, stand the handsome houses of the old French officials. They are grouped in a park beautifully laid out and convey the impression that our predecessors of the Canal did not neglect their personal comfort. The residence of de Lesseps is a particularly attractive structure of two stories surrounded by a double pier of verandahs. Back of the city upon the mainland is Mount Hope, or Monkey Hill, whose cemetery has a population greatly in excess of that of Colon. A small portion of the city has enjoyed the comparative advantage of a water supply derived through a small iron pipe from a reservoir near Mount Hope. The water is of indifferent quality and the quantity is often insufficient even for the needs of officials and employees of the Panama Railroad. Aside from these favored few, the inhabitants of Colon depended for their drinking water upon rain that was stored in iron tanks. At times in the dry season this was very far from fresh and the stagnant water in the cisterns afforded the most perfect breeding places for disease-dealing mosquitoes. The Panama Canal Commission is eradicating this condition with as little delay as need be, but it has encountered serious difficulties in the matter. There is not anywhere in the vicinity of Colon a suitable and sufficient surface water supply available, but it is hoped that a subsurface supply may be secured from the deep strata of sands and gravels transversed by the canal line to the south of the city.

In the matter of sewerage Colon has been even more deficient, and the low site upon which the city is built renders the problem of establishing a system a difficult one. The Commission has decided that the lowest portions of the town must be elevated and the material excavated from the inner harbor will be used as filling for this purpose. In other places it is designed to cut channels, through which the tidal water may ebb and flow. The work upon these much-needed improvements is in active progress and will be completed before long. When these sanitary measures are in effect Colon should be a not unhealthy place. The splendid work that has been done by the medical corps under Colonel Gorgas, the redeemer of Havana, will be described in another place.

A COMPARATIVELY HEALTHY TOWN.

Despite its known disadvantages and extremely forbidding aspect Colon has a record in the matters of health and mortality that compares favorably with that of Panama and belies the apparent conditions. Yellow fever has rarely appeared at Colon and malaria is seldom contracted there. Perhaps the city owes its comparative healthfulness to its situation on an island and the fact that a considerable portion of its surface is washed by sea water in which, it is said, mosquitos will not breed.

Time was when the word Panama suggested untold wealth and voluptuous luxury. That was in the halycon days when the old city, designated the Key to the Pacific and the Gate of the Universe, was the receiving point for the gold of Darien, the pearls of the Gulf islands, and the silver from the mines of South America. Fabulous treasure was often stored in "Panama, the Golden," awaiting a favorable opportunity for carriage by the king's horses over that splendid engineering achievement, the paved way that crossed the Isthmus to Porto Bello.

THE DEPARTED GLORY OF PANAMA VIEJO.

Panama Viejo was a beautiful city. On either side stretched a picturesque tree-lined coast. In the background the mountains reared their rugged heads and between them and the city rolled a noble savanna laid out in fertile fields and lovely drives. The city contained twelve thousand or more buildings. Many of the grand mansions were built of stone and others of aromatic cedar. There were palatial public buildings; a handsome stable for the king's horses, and a castellated depository for the king's treasure. The churches were gorgeous and their plate and fittings world-famous. There were no fewer than eight monasteries and a magnificent hospital. The viceroy maintained a regal splendor; his suite and the many

other wealthy inhabitants lived in the greatest luxury. The natives were their slaves. Money poured into their coffers without any exertion on their part. They merely took their ease and collected toll of the minerals going to the east and of the merchandise passing through Panama on its way to Asia and the Pacific islands.

PANAMA'S WEALTH ATTRACTS THE BUCCANEERS.

There was no wall around Old Panama; no need appeared to exist for any. Spain was supreme upon Tierra Firma, and no enemy was to be looked for from the Pacific side. The situation seemed secure and the Spaniards are to be excused for not anticipating the audacious enterprise of the buccaneers.

The wealth and prosperity of Panama was at once the wonder and the envy of the world. It excited the cupidity of the adventurous privateers whose base was the West Indies, and the boldest among them, Henry Morgan, planned an expedition against the golden city.

A writer says of this extraordinary ruffian, that he was "brave and daring" (his sole redeeming qualities), "of a sordid and brutal character, selfish and cunning, and without any spark of the reckless generosity which sometimes graced the freebooter and contrasted with his crimes. He was a native of Wales, and the son of a respectable yeoman. Early

inclination led him to the sea; and embarking for Barbadoes, by a fate common to all unprotected adventurers, he was sold for a term of years. After effecting his escape, or emancipation, Morgan joined the buccaneers, and in a short time saved a little money, with which, in concert with a few comrades, he equipped a bark, of which he was chosen commander."

MORGAN'S EXPEDITION TO THE ISTHMUS.

Having assembled nine ships and boats, with four hundred and sixty men of all nations, Morgan set out to take Porto Bello as a preliminary step to the greater enterprise. Porto Bello was a fortified stronghold, but it was captured after a fierce fight. A number of nuns and friars were seized before they could find refuge within the walls and they were compelled by the buccaneers to advance before them and place the scaling ladders. For fifteen days the freebooters gave themselves up to the demoniac license that always marked their success on such occasions. At the end of that time, having thoroughly pillaged and sacked the city, Morgan withdrew in his ships, after sending a message to the Governor of Panama, assuring him that he might expect a visit from the buccaneer chieftain at no distant date.

Toward the close of 1670, Henry Morgan had completed his preparations for another expedition to the

Spanish Main, with Panama as the ultimate objective. The force under the command of the pirate on this occasion consisted of thirty-seven vessels, well armed and provisioned, and two thousand desperate cutthroats eager for plunder and ready to dare any danger. They set out with a grim determination that no power on earth should stay their advance on Panama.

Port Bello was recaptured and the castle of Chagres at the mouth of that river was reduced with much slaughter, less than ten per cent of the garrison of more than three hundred being left alive. In starting across the Isthmus, Morgan made the great mistake of failing to take more than one day's provisions. He expected to be able to forage upon the country, but in this he was deceived, and the party was reduced to the utmost straits in the weary nine days' journey. "Throughout the whole track to Panama the Spaniards had taken care not to leave the smallest quantity of provisions, and any other soldiers than the buccaneers must have perished long before even the distant view of the city was obtained, but their powers of endurance, from their hardy modes of life, were become almost superhuman. At nightfall, when they reached their halting place, happy was he who had reserved since morn any small piece of leather whereof to make his supper, drinking after it a good draught of water for his greatest comfort."

At length they stood upon the summit of the Pacific slope and shouted with joy at the sight that met their eyes. In the distance was the South Sea, and on its placid waters ships sailing in and out of the port of Panama, whose city was still hidden by intervening elevations. In a valley below the eminence upon which they stood, herds of cattle peacefully grazed. The pirates rushed among the animals and, slaughtering them, devoured their flesh raw. After this savage feast they pushed on and soon the plain of Panama lay before them with the city on the farther side.

THE PIRATES ATTACK THE CITY OF PANAMA.

The strange battle commenced in the early morning of the following day. The Governor of Panama, who commanded in person, had drawn up, on the savanna, a force composed of two hundred cavalry, four regiments of infantry and a number of Indian auxiliaries. The buccaneers were posted in a well-selected position on an eminence protected in front by a swamp, into which the cavalry floundered at the outset of the engagement. In the force of the freebooters were two hundred picked marksmen who did excellent service. At the end of two hours the horsemen broke and fled, followed by the infantry, who threw away their muskets in the panic. The city was yet to be taken, and, after a brief rest, the

buccaneers advanced to the assault in the face of big guns, that were posted at the main approaches. The fighting was desperate on both sides, and the slaughter terrible. Six hundred Spaniards are said to have fallen during the day, and the loss of the buccaneers could not have been less. After a savage struggle of three hours, maintained in the streets, the pirates gained completed control of the city.

THE CITY IS SACKED AND PUT TO THE TORCH.

The horrors of the sack may be left to the imagination of the reader. The beautiful city was put to the torch and most of its finest buildings were gutted by the flames, whilst those of wood were entirely destroyed. The plunder secured by the pirates was much less than they had anticipated. Many of the inhabitants had concealed their valuables and the priests had deposited the church plate and jewels in places of safety. Several vessels had put to sea laden with property and a galleon had escaped with the king's treasure.

Today one must look for the ruins of *Panama Viejo* amidst a rank growth of tropical vegetation, above which rears the sturdy tower of St. Augustin, at whose altar Pizarro made votive supplication before setting out upon his momentous voyage to the south. The sudden and tragic fall of the old city, in the pride of its beauty and strength, had a de-

pressing effect upon the Spaniards and left them with no heart to resurrect it. They transferred the capital to a site about six miles to the west, but the glory of "Panama the Golden" was never revived in its adumbrant successor.

NEW PANAMA BUILT WITH REGARD TO DEFENSE.

In building the new Pacific port the Spaniards were not unmindful of the lesson taught by the buccaneer raid. The city was laid out upon a rocky peninsula, the whole of which is occupied by it. A wall, thirty to forty feet in height and of solid masonry, in places sixty feet broad, skirted the entire shore. Along the bay-front the outer wall was reinforced by another, and the intervening space formed a moat. This wall and its accessories cost more than eleven millions of dollars, despite the fact that the natives were forced to render almost gratuitous service in its construction. Much of the wall still remains in a good condition of preservation. It is used as a promenade by the citizens and as a playground by their children. The moat has long been dry and some of the poorer dwellings have been raised within it. There is a story of a king of Spain who was noticed one day to be looking out toward the west from a high window of his palace. A minister, who remarked the strained expression of the monarch's eyes, ventured to enquire what might be the object

of his anxiety. "I am looking," said the king, "for those costly walls of Panama. They ought to be discernible even at this distance."

THE HOUSES AND CHURCHES CONVERTIBLE INTO FORTS.

All the old buildings of Panama were designed for use as forts in case of need. The houses have walls of stone, three feet thick, with heavy doors, often iron-clad, and windows only in the second story. Similar precautions were observed in the construction of the churches. Their sides were made to resist the heaviest artillery of the day, and their windows stand sixteen or twenty feet above the ground. These defensive measures were justified by after events, for, although Panama the later never fell into the hands of an enemy during the Spanish dominion, its strength alone saved it from attack on more than one occasion. Shortly after its foundation an unsuccessful attempt to take it was made by a force of buccaneers. That extraordinary man, Captain Dampier, took part in this enterprise.

The substantial houses of Panama are much like those of the old Spanish colonies in other parts of the world — solid, heavy, forbidding structures, the upper story of which alone is occupied by the owners. In Panama, as in San Juan and Manila, the best families are to be found living over a herd of

natives, or negroes, unless the ground floor is given up to a store, or workshop. The lower portions of the houses seldom have any windows in front, and if any exist, they are strongly barred. A verandah, overhanging the sidewalk, is the evening resort of the occupants of the upper half of the dwelling.

The streets, paved with cobble-stones, are tortuous and often very narrow. There is too much congestion for health, or convenience, and the proposed improvements in this direction will be a boon to the inhabitants. It is gratifying that, unlike the people of other Spanish-American cities which have been treated to a clean-up by us, the Panamans are immediately appreciative of our efforts in their behalf.

THE INTERESTING CHURCHES OF MODERN PANAMA.

The churches and ecclesiastical ruins of Panama present a rich field for the research of the antiquarian and the architect, and a capable writer might find material for a highly interesting volume in them. "The oldest church is that of San Felipe Neri, in the long past the parish church of the city within the walls. Its side is on a narrow street, and over the sole entrance one reads, 'San Felipe Neri, 1688,' cut in a shield." The early Spaniards were famous for making cements, both colored and uncolored. So hard were they that they have stood the effects of the heat and moisture of that destructive climate

without damage. This old-time cement today is as hard as stone. Over the entrance to public buildings and churches they made their inscriptions in these cements, in many instances filling in odd spaces with ornamental work made of the large pearl shells from the famous *Islas de Perlas,* or Pearl Islands, in the Gulf of Panama. Such designs when new must have been chaste and beautiful, as the smooth mother-of-pearl surfaces of the large shells on a background of reddish cement must have made a beautiful contrast, the shells reflecting the sun rays in a thousand directions. "This quaint and most substantial old edifice faces on a small street. At one time it made the corner of the Plaza San Francisco. The large door is reached by a few stone steps on either side of which are plain columns, while there are a few lancet shaped windows above. Its front is very plain. The whole is surmounted by a quaint old tower of the true Moorish type. It is built wholly of stone with a rounded cupola of the same material. Lashed to cross-pieces are the old-time bells. The door is a huge affair of most substantial make, studded with huge brazen heads or knobs. When closed from within, persons in the church could stand a siege very successfully. The side windows of the church are fully twenty-five feet above the street, and they were purposely so made in case of attack. The walls of San Felipe Neri are nearly five feet thick, and the windows are so deeply recessed as to

remind one of an ancient fortress or prison." A larger, and not less interesting church is that of San Francisco, facing upon the square of the same name. It was built early in the eighteenth century. The interior is very imposing with its gracefully arched roof and fine supporting columns, dividing the entire length of the edifice. The altar is an exceedingly large and beautiful structure of carved hardwood.

THE FAMOUS FLAT ARCH OF ST. DOMINIC.

A strange story attaches to the ruins of St. Dominic. When intact, it must have been an extremely handsome edifice, but its noble towers and grand façade are things of the past, and the massive remains of the old church are now overrun by vegetation. The most striking portion of the building has survived the attacks of fire and the shocks of earthquake. It is one of the most peculiar arches in the world. It stands complete near what was the main entrance. It is a single span of about sixty feet, its chord so flattened as to be almost horizontal. Architects are puzzled to account for this arch standing without further support than the terminal columns. Legend has it that this curious structure was erected three times and each time fell. A fourth time it was set up and the monk who designed it stood beneath the arch and declared that

if it should not fall upon his head the work was good and would endure.

The churches of La Merced, San Juan de Dios, St. Ana, and the Cathedral, deserve description if space permitted. Nelson makes an interesting statement with regard to the origin of the last-named building: "The cathedral of Panama was built at the sole expense of one of the bishops of Panama, and was completed about 128 years ago. The bishop's father was a Panamanian by birth — a colored man. He made charcoal near La Boca de la Rio Grande, or the mouth of the Grand River, a stream entering the Bay of Panama some two miles from the Panama City of today. This colored man made his charcoal and brought it on his back from house to house to sell — a custom that obtains to this day. He gave his son, the future bishop, as good an education as was possible. In due time he became a deacon, priest, and finally bishop of Panama — a bishop of proud Panama, for in those days it was a wealthy city. He was the first colored bishop of Panama. This son of a charcoal burner developed into a grand man, and in time crowned a life of usefulness by building the cathedral from his private means." Much of the stone used in its construction is from the highlands of the interior, and was brought many leagues on the backs of men. After long years the building was completed in 1760.

The churches of Panama are both numerous and

noisy, facts that are impressed upon the stranger by the almost incessant clanging of their bells. Panama has been the scene of three or four great fires, in which several ecclesiastical buildings were damaged or destroyed.

THE DEAD ARE TEMPORARY TENANTS OF THEIR GRAVES.

The city has several cemeteries, but the system of temporary tenancy forbids any calculation of the number of past occupants. When a graveyard becomes crowded the coffins are taken up, the bones shaken out in a heap, and the empty receptacles offered for sale, or hire. The same system of leasing space is in force in the *boveda* enclosures. A *boveda* is a niche just large enough to accommodate the coffin of an adult. The cemetery is formed of a quadrangle surrounded by three tiers of *bovedas*. These are rented for a term of eighteen months, and after a coffin is deposited in one, the opening is closed with a slab, or bricked up. Where the space has been permanently secured, a memorial tablet often seals the aperture. When the rent of one of these sepulchers is overdue its contents are thrown out in just as business-like a manner as that in which a harsh landlord might evict a delinquent tenant. Perhaps the foregoing statements ought to have been made in the past tense, for the Canal Com-

Church of San Francisco, Panama.

mission, in the exercise of its right of control in sanitary matters, will doubtless strictly prohibit all such practices. There has been an abatement of the evil in recent years as a result of the protests of foreigners. This disgraceful custom of disturbing the dead was confined to the natives. In the Chinese cemetery and in that of the Jews, corpses have been permitted to rest in peace, and it goes without saying that such has been the case in the burial grounds controlled by the railroad and canal companies.

IN SPANISH-AMERICA GRAFT EXTENDS TO THE GRAVE.

One would naturally infer from the conditions, that the Panamans entertained no respect for the memory, or bones, of their deceased relatives, but such is not the case. The truth is that the system of renting graves is an exhibition of the "graft" that has for ages pervaded every rood of territory under Spanish rule. The right to conduct a cemetery, like the privilege of running a gambling establishment, was farmed out to the highest bidder, and the *concesionero* might regulate his business in almost any manner he pleased. The price of a permanent grave was placed so high that the poorer classes could afford no more than a temporary lease, and when that had expired often found themselves unable to renew it. The fact that they did not dispense with consecrated ground, as they might have been excused

for doing under the circumstances, is sufficient evidence of their regard for the welfare of their dead.

The stranger in Panama is struck by the large number of saloons and low groggeries. They are on every hand and remind one of Port Said in the seventies. These places are well patronized by the mixed lower class of the city who account for fully two-thirds of its population of eighteen thousand. There are dissipated Indians, vicious negroes, half-castes of various combinations, an occasional Chinaman, and even a few European loafers. Alcohol is poison in this climate and the alcohol they drink would be poison anywhere. The liquor traffic was encouraged by the Colombian Government, which had a monopoly of the wholesale business. Gambling also enjoyed the friendly countenance of the clique of politicians at Bogota, who received tribute from it. There is every reason to believe that Panama, under American guidance, will redeem its reputation in this and other undesirable respects. The Commission has instituted a high license within the Zone with markedly good effects.

AMERICAN AUTHORITY IN THE PANAMAN REPUBLIC.

The recently effected treaty with the Republic of Panama gave to the United States jurisdiction in the matter of sanitation and order, beyond the limits of the Canal Zone, into the cities of Colon and Pan-

ama and over the adjacent waters. The Commission has in mind to make Panama a clean and, at least, moderately healthy city, and there is no doubt whatever about the ultimate accomplishment of its purpose. The task is a stupendous one, and the difficulties involved by it are fully appreciated, but it has already been attacked and plans are laid for a thorough transformation of the capital. Panama has existed without a water supply, or a sewerage system, for more than three centuries, and a magazine writer recently remarked that it would not seem to matter greatly if it were left in the same condition for another decade or so. That, however, is not the way in which the Commission views the matter. These defects will be immediately remedied and, indeed, a great deal toward their removal has already been accomplished.

PANAMA ENJOYS THE BOON OF GOOD WATER.

By the enlargement of a dam, which the Pan Canal Company had constructed at the headwater the Rio Grande, an extensive reservoir has b formed. The water will be piped from this to anot reservoir, on the summit of a small hill at Ancon, ha ing a capacity of one million gallons. Thence it wil flow by gravity to the city. The system is designed to furnish sixty gallons a day per head to a population of thirty thousand. At points on the

public places, where portions of the population may not have sufficient means to make house connections, hydrants have been placed, so that an unlimited supply of good water may be obtained without cost or difficulty. Before deciding upon the source of the supply, the Commission submitted samples of the water from the upper, or Rio Grande, reservoir to expert bacteriologists and chemical analyzers. After thorough tests the water was pronounced satisfactory before even the banks and bed of the reservoir had been cleaned of vegetation.

The city has a few surface drains, but as they have been laid for the most part without regard to grade they are in many instances worse than none. The water in these conduits is frequently stagnant, or almost so, and impregnated with decaying vegetable and animal matter.

A system of sewerage is in course of installation which will care for sixty gallons per head of the population per day and, in addition, one inch of rainfall per hour. This does not provide for the disposal of the maximum precipitation in the rainy season, but any excess over the capacity of the sewers will be carried through surface channels. The sewerage system, with a total length of nearly eighteen miles, will serve every portion of the city, and may be readily extended to the proposed addition, or to outlying districts.

VI.

PANAMA.

THE PANAMA CANAL COMPANY.

Columbia's Concession to the French Promoters — Conclusion of the International Conference — Ferdinand de Lesseps Diplomatist and Promoter — Froude's Characterization of the French Management — Ruinous Financing From the Outset — The Promoters Feathered Their Nests Comfortably — The Organization of the Panama Canal Company — Reckless Estimates of the Cost of Construction — The Stock Is Oversubscribed by the Public — The Company Commences the Work of Construction — A Simple Undertaking According to de Lesseps — The Company Seeks Authority to Issue Lottery Bonds — De Lesseps Weakens Under the Pressure of Difficulties — An American Officer Inspects the Operation — Signs of Collapse Begin to Be Evident — The French Public Refuses to Subscribe Further Funds — A Receiver Takes Over the Panama Canal Company.

Whilst the American Interoceanic Canal Commission was investigating the comparative merits of the various isthmian routes, a project for a waterway through the Isthmus of Panama was set on foot in France.

In 1875 the subject was discussed at length by the Congres des Sciences Geographiques at Paris, which strongly recommended the immediate prose-

cution of surveys with a view to decisive action. Following the session of the Congress a provisional company was formed by General Türr and other individuals for the purpose of securing a concession from the Republic of Colombia. This syndicate was composed of speculators whose sole motives were of a commercial nature. They despatched to the Isthmus Lieutenant L. N. B. Wyse, an officer of the French Navy and a brother-in-law of General Türr, with instructions to select a route and negotiate with the Colombian Government for a concession. In making his selection the Lieutenant was to be guided by a consideration for the prime object of the syndicate, which was to make as large a profit as possible from the sale of whatever interests it might acquire. Wyse and his employers were not actuated by any utilitarian sentiments, but merely by a desire to make money out of the scheme regardless of ultimate consequences. The spirit that moved them in the promotion was exhibited by their successors in the conduct of the enterprise, the management of which was "characterized by a degree of extravagance and corruption that have had few if any equals in the history of the world."

COLOMBIA'S CONCESSION TO THE FRENCH PROMOTERS.

Lieutenant Wyse made a perfunctory survey, commencing at Panama and extending only about two-

thirds of the way to the Atlantic coast. Nevertheless, he calculated the cost in detail and claimed that his estimate might be depended upon to come within ten per cent of the actual figures. The Colombian Government entered into a contract with the Lieutenant which in its final form was signed two years later. It gave to the promoters the exclusive privilege of constructing and operating a canal through the territory of the Republic without any restrictive conditions, excepting that if the route adopted traversed any portion of the land embraced in the concession to the Panama Railroad the promoters should arrive at an amicable arrangement with that corporation before proceeding with their operations. On the part of the concessionaires it was agreed that the course of the canal should be determined by an international congress of engineers.

The concession was transferred to La Compagnie Universelle du Canal Interoceanique de Panama, generally known as the "Panama Canal Company," and on the fifteenth day of May, 1879, the International Conference met to determine the route. It was composed of one hundred and sixty-four members, of whom more than half were French and the remainder of various nationalities. Forty-two of the members only were engineers. The proceedings were pre-arranged and those who knew most about the subject in hand found that their opinions were least in demand. The following conclusion was put

to the vote and carried by a small margin, the engineers who voted affirmatively being in a minority:

CONCLUSION OF THE INTERNATIONAL CONFERENCE.

"The conference deems that the construction of an interoceanic canal, so desirable in the interests of commerce and navigation, is possible and, in order to have the indispensable facilities and ease of access and of use which a work of this kind should offer above all others, it should be built from the Gulf of Limon (Colon) to the Bay of Panama; and it particularly recommends the construction of a ship canal on a level in that direction."

It was at this meeting that Ferdinand de Lesseps made his first public appearance in connection with the enterprise. He took the chair and dominated the sessions of the Conference, and there is no doubt that his will was the most potent influence in bringing about its decision. Several members, who were radically opposed to the conclusions, rather than declare their difference from the opinions of a man of the great distinction and high reputation that de Lesseps enjoyed at the time, absented themselves when the final vote was taken.

FERDINAND DE LESSEPS, DIPLOMATIST AND PROMOTER.

Ferdinand de Lesseps was born in France in 1805. At an early age he entered the consular service of

his country and on more than one occasion distinguished himself in critical emergencies. In 1854, he visited Egypt and conceived the idea of the Suez Canal. For several years the opposition of the British Government obstructed his efforts to carry out the great undertaking which was eventually brought to a successful conclusion by him. He also promoted the construction of the Corinth Canal.

De Lesseps was at the height of his reputation when he assumed the direction of the ill-fated Panama venture. His great intellect may have been on the wane, but it is certain that his self-confidence and boundless belief in his own abilities were never greater than when he made the declaration, that "the Panama Canal will be more easily begun, finished and maintained than the Suez Canal." The disgraceful failure that resulted must be attributed largely to de Lesseps himself. He publicly assumed the responsibility for the enterprise and its management from the outset. Although he was not an engineer and had but a very limited knowledge of the science of engineering, he considered himself better informed than men who had the advantage of technical training and experience. He laid out the work, acting upon data which a professional engineer would have deemed insufficient or unreliable. With fatuous disregard for the opinions of experts, he altered plans and estimates to conform with his own unsupported ideas and, in, short, exercised an ar-

bitrary and unwise control over every feature of the undertaking. Almost to the last he cherished the belief that he enjoyed the unbounded confidence of the French people and that their purses would never be closed to his demands. Although his plans were fatally faulty and largely impracticable, there is no reason to doubt de Lesseps's good faith in the earlier stages of the enterprise. As it advanced and the errors of his basic calculations were forced upon him, he resorted to deception and, with the constantly increasing difficulties of the situation, his words and actions took an ever increasing divergence from the direction of truth and honesty.

Notwithstanding that the project was essentially a French one, and the money absorbed in it was subscribed in France, the interest in it was universal, and the collapse of the Company caused widespread excitement. Not the least serious of the results was the discredit cast upon the whole question of interoceanic communication and especially upon the Panaman phase of it. Exaggerated pessimism succeeded to the optimistic hopes which attended the launching of the venture and even after this lapse of time doubts of its practicability are extensively entertained. Such doubts, however, can not find a logical basis in the fiasco produced by the Panama Canal Company. Its entire enterprise was built upon an unstable foundation. The plans were conceived in error and in ignorance of some of the most potent

factors in the problem to be solved. Important circumstances were overlooked or inadequately provided for. Available knowledge was neglected and past experience disregarded. One man's preconceived ideas were applied to the situation in substitution of a scientific study of the conditions. The original miscalculations were followed by a series of avoidable mistakes, the inevitable consequence of which was the final disaster.

The mismanagement of the undertaking amply sufficed to insure its failure, but the catastrophe that ensued was rendered greater by the insane extravagance and the unbounded corruption which characterized the conduct of the Company. Froude, in his book on the West Indies, says:

FROUDE'S CHARACTERIZATION OF THE FRENCH MISMANAGEMENT.

"In all the world there is not, perhaps, now concentrated in any single spot so much swindling and villainy, so much foul disease, such a hideous dung heap of moral and physical abomination, as in the scene of this far-famed undertaking of nineteenth century engineering. By the scheme, as it was first propounded,* six and twenty millions of English

* The noted author meant to say, the equivalent of "six and twenty millions, etc." Very little English money was invested in the scheme.

money were to unite the Atlantic and Pacific oceans, to form a highway for the commerce of the globe and enrich, with untold wealth, the happy owners of original shares. The thrifty French peasantry were tempted by the golden bait and poured their savings into M. de Lesseps's money box."

Commenting upon the causes that contributed to the failure, a writer in the *Forum* stated that "following his acknowledged principles of being sole arbiter of the companies which he founded, M. de Lesseps has directed every step without counsel, control or, it may be added, knowledge of what was required. His eyes has been bent steadily upon the Bourse. He has never put forward a single estimate that has not been falsified by the event. For the work of a responsible engineer he has substituted the action of what he called consultative committees, superior councils, and the like, which have been, for the most part, little more than picnic parties at public cost, and with the recommendations of which he has dealt as he thought fit."

RUINOUS FINANCING FROM THE OUTSET.

The first and a continuous drain upon the financial resources of the Company was in the form of "founders' profits." At the initial meeting of the shareholders, when they all fondly imagined that the venture was a bonanza, they were informed that

they had to pay the following claims, and accepted the statement without a murmur:

ESTABLISHMENT EXPENSES OF THE PANAMA CANAL COMPANY.

For the Concession	$2,000,000
Preliminary Expenses	2,160,000
Profit on Preliminary Expenses	2,360,000
American Financial Group	2,400,000
Total	$8,920,000

The greater part of this sum was taken by the founders out of the first $20,000,000 paid in. It is doubtful if any of the outside shareholders knew precisely, or even approximately, what these figures represented. They were too absorbed in visions of vast prospective profits to concern themselves overmuch with present expenditures.

In addition to the immediate cash benefits the founders were to receive fifteen per cent of the net profits of the Company. These prospective payments were capitalized under the name of *parts de fondateur* in "parts" of 5,000 francs each. There were originally five hundred and later nine hundred of these "parts," which attained a price of 80,000 francs each. De Lesseps is authority for the statement that in November, 1880, they sold at 380,000 francs each.

In 1883 the promoters netted $716,900 and the directors and staff, $186,900, out of the "profits" of the undertaking. The directors were allowed a further three per cent of the profits, which contingent benefit they commuted into a present payment of $48,000.

RECKLESS EXTRAVAGANCE ON THE ISTHMUS.

Dr. Nelson, who was upon the ground whilst the Panama Company's operations were in progress, makes the following statement: "The famous Bureau System is what has obtained in the Isthmus up to the present time, with changes and amplifications without number. There is enough bureaucratic work, and there are enough officers on the Isthmus to furnish at least one dozen first-class republics with officials for all their departments. The expenditure has been something simply colossal. One Director General lived in a mansion that cost over $100,000; his pay was $50,000 a year; and every time he went out on the line he had his *deplacement,* which gave him the liberal sum of fifty dollars a day additional. He travelled in a handsome Pullman car, especially constructed, which was reported to have cost some $42,000. Later, wishing a summer residence, a most expensive building was put up near La Boca. The preparation of the grounds, the building, and the roads thereto, cost

upwards of $150,000. . . . Another man had built a large bath-house on the most approved principles. This cost $40,000. Thousands and tens of thousands have been frittered away in ornamental grounds, for all had to be *beau,* utility being a secondary consideration."

THE ORGANIZATION OF THE PANAMA CANAL COMPANY.

We will now resume the history of the Panama Canal Company. It was capitalized at 400,000,000 francs in shares of 500 francs each, which were opened to public subscription in Europe and America in August, 1879. Less than one-tenth of the amount was taken up and the organization of the corporation was indefinitely postponed. In the criminal trial that followed the failure of the Company, Charles de Lesseps stated that after the abortive effort to float the Company his father placed the financial arrangements connected with the disposal of the shares in the hands of an influential group of financiers and journalists, who undertook to mould public opinion to a favorable form. Here we find the explanation of three of the enormous items of preliminary expense which are given above. Early in 1880 M. de Lesseps arrived at Colon, accompanied by an international technical commission which was charged with the work of making the final surveys and marking the precise line to be

followed by the Canal. This highly important task, like all the other preliminary steps of the undertaking, was performed in haste and the party left the Isthmus before the close of February.

RECKLESS ESTIMATES OF THE COST OF CONSTRUCTION.

The Paris Congress had estimated the cost of constructing the Canal at 1,070,000,000 francs and the time necessary for its completion at twelve years. The technical commission expressed the opinion that the entire operation might be finished in eight years at a cost of 843,000,000 francs. In view of the fact that several of the engineer-members of the congress considered the former estimate too low, it is difficult to understand how the commission arrived at its figures. The reduction was not, however, sufficiently great to satisfy the purpose of de Lesseps, which was to present to the public a proposition so attractive as to be irresistible. In order to promote this object, he took upon himself to alter the sum fixed by the commission to 658,000,000 francs, which he declared would be sufficient to provide for the entire expenses of the operation. The first year's traffic was estimated at 6,000,000 tons assuring a revenue of 90,000,000 francs and this was claimed to be a very conservative assumption, whereas, it was in

* An approximate equivalent of this sum in dollars may be arrived at by calculating five francs to the dollar.

reality almost beyond the possibility of realization. The limit of fanciful prediction had not, however, been reached. In May, 1880, Mr. A. Couvreux, Jr., a member of a large contracting firm, publicly stated that his house was prepared to undertake the entire work at a cost of only 512,000,000! In the light of our present knowledge the absurdity of these statements is patent, but we must remember that at the time the whole proposition rested upon a basis of theory. The fact should have been an incentive to conservatism and, although there may not be sufficient ground at this stage of the enterprise to impugn the honesty of the promoters, the recklessness with which M. de Lesseps submitted his inexpert calculations to the public was little short of criminal.

THE STOCK IS OVERSUBSCRIBED BY THE PUBLIC.

Having prepared his new financial prospectus on the alluring lines indicated M. de Lesseps made a tour of the United States, England, Belgium, Holland, and France, delivering speeches in which the enormous profits to accrue to the fortunate investors in the Panama Canal project were depicted in the seductive rhetoric that was always at his command. Following this campaign of words, 300,000,000 francs in shares of 500 francs denomination were offered to the public and doubly subscribed for.

It was agreed that the first two years should be

a period of organization to be devoted largely to surveying and ascertaining from actual experience something of the cost of excavation and other features of the operation. In other words, the public having invested its money upon the strength of certain wild guesses advanced with all the assurance of conviction it was now proposed to investigate the facts. Later developments proved that even the surveys of the line were unreliable. Three years after the engineering force had been at work upon the ground it was discovered that what they supposed to be an almost fathomless swamp was composed of solid rock a few feet below the surface and this was only one of a number of similar misapprehensions which from time to time necessitated changes in the plans.

The second period, of six years, was to be occupied with the actual work of construction under contract.

THE COMPANY COMMENCES THE WORK OF CONSTRUCTION.

In February, 1883, the latter stage was entered upon with Mr. Dingler as engineer in chief. His plan for a sea level canal made the following provisions: The canal, which had its origin at Colon, in Limon Bay, was to follow the bottom of the Chagres Valley for a distance of about 45 kilometers, to Obispo; it was then to cross the Cordilleras, the passage accounting for about 11 further kilometers of

its length; continuing thence, the line traversed the Valley of the Rio Grande and terminated in deep water near the Island of Naos, in the Bay of Panama. The full length of the proposed cut was 74 kilometers. The depth of the canal was to be 9 meters and its width at bottom 22 meters.

For the regulation of the waters of the Chagres, which vary from 20 cubic meters at low water to 2,000 cubic meters in flood, it was proposed to construct a large storage reservoir at Gamboa by damming the river and deflecting its affluents to the sea on either side of the Isthmus.

The cube of the excavations provided for by this plan was a minimum of 120,000,000 meters, being 45,000,000 more than had been estimated by the commission and 75,000,000 more than the congress had indicated.

This plan was accepted and, despite the enormous increase of work entailed by it, de Lesseps adhered for a year longer to his original estimate of cost and time of construction. It was not until a meeting of the shareholders in 1885, that he increased the former to $120,000,000, and extended the latter to July, 1889.

A SIMPLE UNDERTAKING ACCORDING TO DE LESSEPS.

At the inception of the enterprise M. de Lesseps established a Bulletin which became the medium for

the dessemination among the shareholders and the general public of the most exaggerated reports and the most reckless misstatements. In March, 1881, de Lesseps stated in this publication: "But two things need be done: to remove a mass of earth and stones, and to control the river Chagres. . . . The canal is, therefore, an exact mathematical operation." This statement alone betrays the promoter's ignorance of the great engineering problems inseparably connected with the undertaking; for the control of the Chagres involves the most intricate and difficult calculations and engineering works imaginable.

By the middle of 1885, hardly one-tenth of the estimated minimum excavation had been done, and it became evident, even to the non-professional observer that the program could not be carried out in accordance with the assurances repeatedly given by de Lesseps. The enterprise began to be severely criticised and passionately discussed in the press of France. The credit of the Company was seriously affected by these assaults and it became necessary to adopt drastic measures for the restoration of public confidence in order to secure the additional funds that were already needed. At this critical juncture, the promoter, for M. de Lesseps had long since taken the whole affair into his own hands, sought the aid of the Government, which had been extended to him during the Suez Canal operation. He applied for

permission to issue lottery bonds, but the desired authority was not granted at that time.

By this time it was widely recognized that, de Lesseps's declaration to the contrary notwithstanding, the Panama project involved immeasurably greater difficulties than those encountered in the Suez undertaking. In fact, the two operations were so dissimilar in every essential respect that the latter afforded no criteria by which to judge the former. At Suez, the entire line lay along low ground and most of the way traversed lakes, marshes, and swamps. One of the chief difficulties rose from the softness and instability of the material to be dealt with. In Panama the main problems are the passage of a chain of mountains and the disposition of a number of streams. At Suez, the tides are the same at each end of the Canal; at Panama there is a difference of twenty feet between the Atlantic and Pacific extreme oscillations. In the earlier enterprise neither climate nor labor entailed unfavorable conditions, whereas in all the operations upon the American Isthmus they have been among the most vexatious factors entering into the situation. The constructors of the Suez Canal had the support of the French Government and of the Khedive of Egypt, and the encouragement of the whole world. In his later venture de Lesseps started with well-founded opposition against his plans and which steadily increased as the attempted execution of them betrayed

their futility. The comparison admits of extension were that necessary.

In his letter of August the first, 1885, to the Minister of the Interior, praying for authority to raise a loan of 600,000,000 francs on lottery bonds, Ferdinand de Lesseps stated:

"The organization of the working camps, the installation along the whole line of twenty-seven contractors piercing the isthmus at their own risk and peril, an immense stock on working footing, is such as to allow the canal to be completed and inaugurated in 1888."

THE SEA-LEVEL PROJECT INVESTIGATED BY THREE PROMINENT ENGINEERS.

The Chamber of Deputies recommended that the desired permission should be granted to the Company without delay, but the Government decided before complying to send a competent engineer to the Isthmus with instructions to investigate and report upon the situation. At the time that this official was conducting his examination, two other engineers were similarly engaged. Each proceeded independently of the others, but all arrived at one conclusion, which is the more remarkable since two of them were in the employ of the Company. In the fore part of 1886 the reports were submitted to the re spective principals.

Armand Rousseau, the Government commissioner, found that the completion of the Canal with the resources available and in prospect was practically impossible unless the plan was changed to one involving the use of locks.

M. Jacquet declared that after a thorough investigation of the work in all its details he was convinced of the necessity of abandoning the original design and he recommended the construction of a lock canal along the precise line adopted for the sea level project. Leon Boyer, who held the position of Director of Works upon the Isthmus, stated that the completion of a canal on a level was impossible with the money at command and in the time stipulated. He suggested a *temporary* waterway, to be operated by locks and to be replaced by a sea level canal as soon as possible.

This weight of expert opinion, which it must be remembered was in corroboration of similar expressions voiced by eminent engineers on previous occasions, de Lesseps discarded in his usual high-handed manner. He would not listen to a word against the sea level project, but declared in the most emphatic terms his intention to pursue it to the end. He had "promised the world a canal at the level of the oceans," and he proposed to keep his word despite all opposition. At this stage of the proceedings the "Great Undertaker," as he began to be dubbed, assumed the role of the persecuted philanthropist.

The shareholders of the Company were frequently informed henceforth that all kinds of powerful interests were in league against their enterprise, but at the same time they were assured that he, de Lesseps, might be depended upon to circumvent the machinations of these wicked plotters.

Lest the reader should fall into misapprehension as to the true significance of the recommendations of the engineers which have been cited, it may be well to remind him that the undertaking of the Panama Canal Company was a purely commercial enterprise, and that the reports and suggestions of the experts in question were made with that fact constantly in mind. None of them expresses the opinion that a sea level canal is impracticable, nor is the question taken into consideration by either of them directly. The point of their decision was whether a sea level canal could be constructed at a cost and in such time as to make its after operation a profitable business for the shareholders. Time, of course, is a great factor in the cost of an operation involving hundreds of millions. Interest increases at an enormous rate during the later years. Therefore, considerations which would preclude the pursuit of a project solely contemplating commercial results might not be of sufficient weight to deter a government from following the same lines. The United States, observing business principles to the utmost reasonable extent, might justifiably construct a sea

level canal at an expense that would entail the ruin of a private corporation. Even though the operation of the canal should fail to return any interest upon the money invested the Government might well consider itself fully compensated for the outlay by the political advantages secured, the great savings in the movements of warships, and other desiderata which will be noticed in detail in later chapters.

FURTHER EFFORTS TO RESTORE THE WANING CONFIDENCE OF THE PUBLIC.

Whilst the engineer reports to which reference has been made above were in course of preparation, de Lesseps visited the Isthmus with a large party of individuals, many of whom were influential in the commercial and financial circles of France. Few of them had any technical knowledge, but the majority seem to have been susceptible to the persuasive eloquence of the great promoter, for upon their return the enterprise received the endorsements of various chambers of commerce and general boards. In July, 1886, the Government declared its intention of postponing for several months the decision in the matter of the lottery bonds. De Lesseps took umbrage at this action and, relying upon the effect of the moral support of the powerful commercial bodies, withdrew his request. He received from the stockholders permission to issue a new series of bonds, and

did so with success, but the enterprise had passed beyond the stage of possible salvation.

AN AMERICAN OFFICER INSPECTS THE OPERATION.

In March, 1887, Lieutenant C. C. Rogers, U. S. N., was ordered by the Navy Department to inspect the canal work. He took three weeks to the task, and went thoroughly over the line. He found the hospitals and quarters for officers and laborers clean, well-ventilated frame buildings, admirably suited to the climate. The canteens were kept by Chinamen, who boarded laborers at reasonable rates. There were upwards of 10,000 workmen, employed by contractors, who, with the number of the Company's employees, made up a total of 11,566. The laborers were chiefly importations from the West Indies, with a few negroes from the Southern States of America. The standard wage was $1.50 in silver a day. The laborers were paid every Saturday. Sunday was spent in drinking; Monday in recuperation; and on Tuesday they returned to work; "hence," says the lieutenant, "the number of working days in a month seldom exceed twenty or twenty-two." The Company endeavored to put 20,000 laborers upon the ground and, as they could not be had from the West Indies, tried to get them from Western Africa and Southern China, but without success.

The hospital records of the Company showed a death

rate of seven per cent of those employed on the work from its inception to July, 1887, but this did not include the great number who contracted disease on the Isthmus and died elsewhere.

SIGNS OF COLLAPSE BEGIN TO BE EVIDENT.

By this time the work had become seriously disorganized. There had been changes of contractors. Some had thrown up their contracts, others had brought suits against the Company. There had been frequent alterations in the working plans and there was a general feeling of uncertainty as to the character of the future operations.

In the meanwhile de Lesseps had found his attitude on the sea level question untenable and, after a considerable amount of beating about the bush, he consented to what he called "a provisional lock

had the work been carried to a conclusion it must have prohibited the passage of a large proportion of ocean-going vessels. The summit was to be reached by the use of hydraulic elevating machinery.

THE FRENCH PUBLIC REFUSES TO SUBSCRIBE FURTHER FUNDS.

The next step was to procure the necessary funds. Application was again made to the Government for authority to issue lottery bonds and the Company was granted permission to raise 800,000,000 francs in this manner. The bonds of 400 francs denomination were offered at 360 francs each. They were to bear four per cent interest and to be redeemed by a civil amortization association and to share in semi-monthly drawings. The proposition, backed by better security, would have been an extremely attractive one but, to so low an ebb had the Company's credit fallen that only 800,000 bonds were subscribed for. A second attempt to float the bonds, with extra inducements to subscribers, only proved the futility of the effort.

The Company had already issued shares and obligations approximating the immense sum of $350,000,000 for an undertaking which it had promised to complete at a cost of $120,000,000. It now asked for an additional amount of upwards of $133,000,000 for the purpose of constructing a "tem-

porary" waterway with a very limited capacity. Of the vast sums which the Company had expended, $105,000,000 went for interest, administration expenses, bankers' commissions, etc., and less than half was made available for the actual work. The annual interest charge was running in excess of $16,000,000 and at this time the Company had in hand barely sufficient cash to cover one month's current expenses.

Before the close of 1887 a general belief prevailed in England and America, and, perhaps, everywhere but in France, that de Lesseps would never complete the Panama Canal. The failure to place the lottery bonds in the following year showed plainly that at length the French public had lost all confidence in the scheme and its chief promoter, whose statements and estimates had been so greatly, and so often, changed. Bankers could not be induced to handle the loan issues on any terms. The Government was not disposed to advance money to the Company and was itself so involved financially as to put the question of its finishing the canal beyond consideration. It was universally doubted whether the Company could complete the waterway even though it received the money asked for and it was shown that, in the event that it did succeed, its fixed charges would be in the neighborhood of $30,000,000, a sum far in excess of the maximum traffic returns of a sea level canal according to de Lesseps's

largest estimate. So that upon his own showing the project under the most favorable circumstances would be a financial failure.

A RECEIVER TAKES OVER THE PANAMA CANAL COMPANY.

On the fourth day of February, 1889, the civil court of the Seine appointed Joseph Brunet judicial receiver of *La Universelle Compagnie du Canal Interoceanique de Panama.*

We will give a brief statement of the receipts and expenditures of the Panama Canal Company from the date of its organization until the end of the year 1889.*

RECEIPTS.

	Francs.
Proceeds from the Capital Stock, various loans and bond issues....	†1,271,682,637
Other receipts from sundry sources..	39,666,589
Expenses incurred but not paid.....	18,343,851
Total amount collected and due by the Company.....	1,329,693,078

* A few comparatively small sums should strictly come within the account of 1890, but, for the present purpose, may without impropriety be included in the above statement.

† Fractions have been discarded throughout.

EXPENDITURES.

(*Outlay on the Isthmus.*)

Salaries and expenses of management..	82,704,415
Rents and maintenance of leased property	16,505,352
Purchase of articles and material for consumption	29,239,602
Purchase and transportation of machinery, etc.....	119,374,679
Surveys and preparatory work.....	1,354,733
Central workshops and management...	29,947,885
Various constructions, buildings, and general installation.....	47,038,528
Work of excavation and works of construction	447,171,124
Purchase of lands.....	4,753,275
Sanitary and religious service.....	9,183,841
Total expenditures on the Isthmus..	783,273,438

(*Outlay at Paris.*)

Paid for the Concession.....	10,000,000
Paid to the Colombian Government....	750,000
Various expenses incurred before organization	23,061,221
Paid to American Financial Group....	12,000,000
Interest on various obligations.....	215,621,361
Amortization transactions.....	22,528,085

Expenses of floating bonds, loans, etc., commission, advertising, printing, etc.	83,084,203
Paid to agents of the Colombian Government	213,800
Boards of management and direction	6,212,291
Salaries of employees	5,117,221
Sundries	3,713,393
Home Office and furniture	2,087,397
Compensation to contractors on cancellation of contracts	1,200,000
Total expenditures at Paris	390,701,648

SUMMARY.

Receipts from all sources		1,329,693,000
Expenditures—		
At Panama	783,273,438	
At Paris	390,701,648	
Paid for Railroad shares	93,268,186	
In connection with Lottery bonds	32,264,680	
Advance to the Colombian Gov't	2,455,075	
Various debtor accts.	11,455,801	
Cash and negotiable paper in hand	16,274,238	
Total equal to receipts		1,329,693,000

Residences of French Directors, Cristobal.

VII.

PANAMA.

THE NEW PANAMA CANAL COMPANY.

An Effort to Restore to Public Confidence — Steps Towards the Reorganization of the Company — Well-calculated Action by the New Company — Report of the Committee of International Engineers — The Plan of the New Panama Canal Company — General Abbot's Estimate of the Task at Culebra — French Estimates of Cost of Excavation — The Dam and Lock Constructions at Bohio — Alhajuela and Gamboa Dam Sites Compared — Crystalization of American Interest — Appointment of the First Isthmian Canal Commission — The Report of the Commission Favors the Nicaragua Route — French Company Meets Our Bid — The Senate Investigates the Question of Route — The Nicaraguan Route Compared With that of Panama — Nicaragua Route Presents Many Extraordinary Difficulties — Control of Lake Nicaragua a Serious Problem — The Conditions at Panama Are Thoroughly Understood.

The task entrusted to the receiver of the Panama Canal Company was an extremely difficult one. If the affairs of the Company should be wound up it would be impossible to save the shareholders from total, or almost total, loss of their investments, for the property and work which was estimated as worth 450,000,000 francs depended for its value upon a continuation of the operation.

The gravity of the situation, in which two hundred thousand persons, the majority of them in moderate circumstances, were involved, was fully appreciated by the Government and special legislation was effected for the purpose of affording the Company temporary relief from the pressure of its liabilities.

Several circumstances militated against the endeavors of the receiver to reorganize the enterprise. The most serious of these was the public scepticism which had followed the failure of de Lesseps to make even a respectable approach towards the achievement of his undertaking. The shareholders had learned at last that systematic deception had been practised upon them for years, and they felt that they had no reliable knowledge as to the state of affairs at the Isthmus.

AN EFFORT TO RESTORE PUBLIC CONFIDENCE.

The first step in the process of restoring public confidence was the investigation of the commission to which reference was made in the preceding chapter. In addition to the statement of the amount of work done and the value of the plant, the commission gave an opinion that a lock canal might be completed in eight years at a further cost of 500,000,000 francs.

Any hope that might have been derived from this report was, however, dependent upon the success

of the receiver in negotiating new concessions with the Colombian Government, for the time limit, under the contract, for the completion of the canal, neared its termination. Lieutenant Wyse, who had secured the original grant, was sent to Bogota immediately following the submission of the commission's report. After *pourparlers* that extended over four months, a new agreement was signed December the tenth, 1890, providing for an extension of ten years.

In the meanwhile Joseph Brunet had died and was succeeded by Achille Monchicourt. The new receiver applied himself with remarkable energy and acumen to the organization of an active company. He had contrived to keep the work going upon the Isthmus, although the scale of operations was greatly reduced. During the years 1891–3, he settled, by a series of compromises, most of the lawsuits existing with the old company and successfully resisted certain creditors and bondholders who would otherwise have ruined the interests of all concerned.

STEPS TOWARDS THE REORGANIZATION OF THE COMPANY.

In April, 1893, Colombia made a further concession to the receiver, by granting an extension until October the thirty-first, 1894, for the organization of a new company and ten years from that date for the completion of a canal. A few months later "a

special law for the liquidation of the Interoceanic Canal Company" was passed and had the effect of suspending the most obstructive actions before the courts. Early in the following year, death relieved Achille Monchicourt and his place was filled by M. Gautron. There remained but a few months in which to effect the organization of the new company and, with the co-operation of the attorney for the bondholders, the receiver bent his energies to the task. They secured the co-operation of the managers of the old company, the contractors, and certain other interested persons, in the new enterprise, in the form of abatements of their claims, and subscriptions to the capital of the reorganization. The amount necessary to complete the full sum was to be asked of the old bondholders and shareholders.

The by-laws of the New Panama Canal Company were filed towards the close of June, 1894. The capital of the company consisted of 650,000 shares of 100 francs each, 600,000 of which were to be subscribed for, whilst 50,000, absolutely unencumbered, were to be given to the Colombian Government in consideration of the contracts granting extensions. Thus, five years after the appointment of a receiver for the Interoceanic Canal Company, what was generally known as the "New Panama Canal Company" was definitely established.

The new company, like its predecessor, was a commercial concern, pure and simple. Although the

French Government, by the exercise of extraordinary legislation, had been largely instrumental in the creation of the company, neither governmental patronage nor responsibility were extended to it.

The directors of the new company appointed a *Comité Technique* to thoroughly examine the whole problem of the canal. This was a wise determination, for the surveys made under the direction of the old company had been of such a cursory character that little reliance could be placed upon them.

WELL-CALCULATED ACTION BY THE NEW COMPANY.

The *Comité Technique* was composed of seven French engineers and an equal number of foreign experts, including several who had the special advantage of experience in canal work. Whilst making careful surveys and maturing plans for the ultimate operations, the committee directed the continuance of excavations in places where they were certain to come within the specifications of any plan that might eventually be adopted. In addition to its original investigations the *Comité Technique* verified and rectified the surveys and measurements of the old company. In short the technical committee performed the most valuable scientific work that has yet been done in connection with the Isthmus and handed over to the Isthmian Canal Commission

maps and documents which Admiral Walker declared to be worth at least a million dollars.

REPORT OF THE COMMITTEE OF INTERNATIONAL ENGINEERS.

The final report of the *Comité Technique* was submitted at the close of the year 1898. It estimated the cost of a canal, which could be completed in ten years, and would be equal to all the demands of commerce, at one hundred million dollars. Aside from the question of health the *Comité* recognized two principal difficulties to be overcome — the cut through the divide and the control of the Chagres. The former, whilst a stupendous task, is merely a matter of excavation and involves no serious engineering problem; the latter, on the contrary, presents features sufficiently intricate and perplexing to tax to the utmost the available technical ingenuity of the world. The solution appears to be susceptible of achievement by several different methods and numerous plans have emanated from sources that command respectful attention.

"The studies of the New Company were based on three fundamental principles: (1) To reject any plan that did not, independently of considerations of time and expense, offer every guarantee of a serviceable canal. (2) To reject any fanciful scheme depending on the application of new and un-

THE CANAL ZONE.

This map shows the line which has been adopted, with slight variations, in all canal projects for this region. Both the sea-level and lock plans of the Consulting Board of Engineers also conform to this route. The profile chart shows the relative elevations.

tried devices not justified by experience; and (3) to give due weight to the peculiar tropical conditions under which the work must be executed. These must compel the employment of a class of laborers inferior to those available in better climates, and the work will be exhausting to those supervising the constructions. No technical details should therefore be admitted involving operations of exceptional difficulty." *

THE PLAN OF THE NEW PANAMA CANAL COMPANY.

The plan provided for the impounding of the floods of the Chagres to about the quantity of 250,000,000 cubic metres. For this purpose it was proposed to increase the area of Lake Bohio to twenty-four square miles.† As this would not, however, accommodate the desired volume, it became necessary to provide for another reservoir. The old company had selected Gamboa as the site of a dam for this purpose, and it has been favored by a recent Isthmian Canal Commission, but the *Comité* decided that the location is "one of the most unfit that can be chosen," and found that the topography of Al-

* Problems of the Panama Canal. Brig.-Gen. Henry L. Abbott, U. S. Army (retired). Late Member of the Comité Technique. New York, 1905.

† It has been deemed advisable, where exactness is not essential, to reject fractions and give closely approximate figures.

hajuela, about ten miles higher up the river, lends itself admirably to all the requirements of the case. A lake of about twelve miles may be formed there, which will hold up to 150,000,000 cubic metres of reserve waters.

The report of the *Comité* includes two plans contemplating two summit levels, of which the bottom of the canal was respectively sixty-eight and thirty-two feet above mean tide. The relative costs of construction were nearly the same, but the fact that a canal at the higher level could be completed in much less time decided the *Comité* to recommend that plan.

General Abbott intimates that but for this consideration it is certain that the conclusion of the *Comité* would have been different. He declares that in the hands of the American Government, with expense a minor condition, "there can be no question that the low level variant should be preferred." Since the prospect at the time of writing (February, 1906) is that the canal will be completed at an eighty-five foot level, it is useless to consider the details of the *Comité's projet,* to which the plan recommended by the first Isthmian Canal Commission closely conformed. The line follows closely that adopted by the old company, which, with slight variations has been accepted by all subsequent technical surveys. Thus the excavations already made will be included in any future operation. More than half the dis-

tance follows straight lines, and in the remainder of the route the highly important feature of curvature leaves nothing to be desired. This is a detail of the utmost consequence as affecting safety of transit and speed of passage. "Experience on the Suez Canal has compelled, since the route was opened to traffic, a costly increase from the original minimum radius of 700 metres (2,300 feet) to 1,800 metres (5,905 feet). On the Panama *projet* the ruling radius is 3,000 meters (9,842 feet), falling occasionally to 2,500 meters (8,202 feet), the minimum being 1,700 meters (5,577 feet), and this latter only for about half a mile in approaching Obispo, where the width is sufficiently increased to justify the reduction."

GENERAL ABBOTT'S ESTIMATE OF TASK AT CULEBRA.

The old company's excavations in the Culebra cut were mainly in disintegrated material near the surface, and they occasioned serious trouble by caving and sliding, much of which might, in the opinion of engineers, have been prevented by proper drainage. The *Comité* made a careful examination of this section and by means of extensive boring and tunneling at a low level established the fact that the dangerous material has already been passed and with ordinary precautions there need be no fear of a recurrence of the disasters to which we have referred. General Abbott remarks that the "remaining exca-

vation is greatly exaggerated in popular estimation, the fact being ignored that a large volume has already been taken out. Thus the height of the continental divide on this route is constantly stated at its original figures, which on the line of the axis of the canal was really 345 feet above tide. The narrow bottom of the cut there has now attained a level but little over 100 feet. In fine, the old phantom of a sliding mountain and an impassable continental divide has been definitely laid at rest by the operations of the New Company. . . . The locus of maximum difficulty,* lying between points 54.1 and 55.3 kilometers from Colon, and only about three-quarters of a mile in length, is what will cause the greatest delay in execution and which, therefore, demands the closest study. . . . The facts make it clear that to complete the work as soon as possible the point of attack must be this length of three-quarters of a mile, and that here every effort must be made to gain time. . . . All the spoil must be transported either to the northerly dump at the Lirio or to the southerly dump at the Mallejon, distant three or more miles apart. Any general plan of operations must therefore deal with two problems — how locally to concentrate the work . . . and how to provide

* That is to say, "the locus of maximum difficulty" in the divide. General Abbott agrees with all other authorities that the Chagres presents the greatest difficulties involved in the enterprise.

for running the trains to and from the dumps without interference and without needless shifting of rails. . . . The study of the local conditions makes it evident that the prompt completion of the cut at the Culebra lies not so much in extreme efficiency of the excavating machines as in the rapidity of transporting the material to the dumps. The frequent shifting of tracks under the heavy rainfall that prevails during seven months of the year, aggravated by the weight of locomotives causes derailments and other delays. The early completion of the Alhajuela dam, permitting the electrical transmission of the water power there developed, would dispense with the use of steam at the cut and thus serve an excellent purpose.

FRENCH ESTIMATES ON THE COST OF EXCAVATION.

M. Choron, the Chief Engineer of the New Panama Canal Company, made the following estimate of probable future work in the cut. He calculated that one excavator working continuously for ten hours per day would take out 994 cubic yards, measured in place, or 1,570 cubic yards measured in bulk. But he considered a reduction of forty per cent necessary in order to allow for the loss of time in removing the material. A further allowance was made for the delays and complications incidental to the opera-

tions in the rainy season and experience had proved that twenty-five per cent discount was not too great a reduction on this account. Thus the basic figure, 994 cubic yards, was brought down to 445 cubic yards per day. The American engineers, into whose hands the problem has come, whilst they have not agreed in their estimates, have all reached figures greatly in excess of M. Choron's result, without disputing the general correctness of his calculations. The former arrive at their conclusions from entirely different bases. In the first place, they find that they can employ American steam shovels, which will perform considerably more work per day than the machines used by the French company. They have devised more than one scheme for the disposal of the spoil in a much more rapid manner than that contemplated by M. Choron. Again, the American plans include the early utilization of the available water power for the generation of electric light, by means of which the work may be continued day and night without cessation, save for a twenty-four hours' interval on the Sabbath day.

THE DAM AND LOCK CONSTRUCTIONS AT BOHIO.

The most important group of construction embraced in the plans of the *Comité Technique* consists of the dam, spillway, and locks at Bohio.

It is not considered necessary to give the details of this dam *projet,* but General Abbott's concluding remarks upon the subject are worth special attention in view of the divergence of opinions as to the most desirable method of regulating the Chagres. "This construction (the Bohio dam) was approved unanimously by all the engineers of the New Company, as meeting all the requirements of the case; and the fact that Mr. Fteley, past President of our Society of Engineers, whose experience in dam construction had been second to none in the United States, cordially concurred with his colleagues in this opinion, should have weight with American engineers. The difficulty of successfully damming the Chagres at this locality has been unduly exaggerated by opponents of the route."

ALHAJUELA AND GAMBOA DAM SITES COMPARED.

Of the proposed Alhajuela dam, the same authority states: "This site is so much superior to that at Gamboa, or to any other between them, that unless the visionary scheme of a sea level canal be contemplated there can be no question that it should be preferred for the necessary upper lake. . . . There are no engineering difficulties in construction, or in conducting the operations at Alhajuela." The foregoing sentence illustrates the striking differences of opinion entertained by the foremost engineers of

the world about the most important features of the canal problem. Mr. Williams, one of the American engineers-in-chief, after ample examination of the rival sites, has given his decisive preference to the Gamboa dam and the Advisory Board of Engineers has decided in favor of the sea level project which General Abbott, and not he alone by any means, characterizes as "visionary."

The scientific information accumulated by the *Comité's Technique* is amongst the most valuable data relating to the Panama Canal extant, and its investigations will undoubtedly afford much of the data for any course that may ultimately be followed in the completion of the work, except in the improbable contingency of a sea level canal being decided upon.

CRYSTALIZATION OF AMERICAN INTERESTS.

By the time the *Comité Technique* had made its report, public sentiment in this country had become strongly impressed with the desirability of a trans-isthmian canal under American control, and a majority in Congress favored immediate action to that end. The Nicaragua route appeared to be the best available at the time and general opinion favored it. The situation thus created caused extreme anxiety to those interested in the welfare of the New Panama Canal Company. It had reached precisely the stage where the directors proposed to appeal to

the financiers of the world, when its prospects were thus suddenly overshadowed. Although firmly convinced that the Nicaragua route was greatly inferior to their own, the company realized that should the United States construct a waterway there, or elsewhere, commercial competition would be impossible. This and other considerations would surely deter investors from backing the private enterprise. Furthermore, with the American Government in the field, the completion of the Panama Canal would be retarded, if not prevented, by the difficulty in securing labor.

In this dilemma the directors decided upon a course calculated to bring the comparative merits of the Nicaragua and Panama routes squarely before the American Government. Since the report of the *Comité* had not been made public, the directors were satisfied that the United States authorities could not possibly have anything like adequate knowledge or appreciation of the superior advantages of their proposition.

The full report of the *Comité Technique,* including details of the *projet* recommended by it, was accordingly placed in the hands of President McKinley during the first week of December, 1898. On the twenty-first day of that month the Senate, by a large majority, passed a bill providing for government support of the Maritime Canal Company in its Nicaraguan enterprise, but the House adjourned

THEODORE P. SHONTS
Chairman of the Isthmian Canal Commission.

without taking action upon the measure. On the reassembling of Congress the French Company secured a hearing before the Rivers and Harbors Committee of the lower house, to whom the Senate bill had been referred on an amendment. The Company's representatives frankly explained their project and expressed the willingness of the Company to re-incorporate under American laws in case the Panama route should be decided upon. The Senate amendment was defeated and, in March, 1899, Congress authorized the President to make an exhaustive investigation as to the most practicable and feasible isthmian route for a canal that should be under the complete control of the United States and the absolute property of the nation.

APPOINTMENT OF THE FIRST ISTHMIAN CANAL COMMISSION.

In accordance with these instructions President McKinley placed the work of investigation in the hands of a body which was officially styled "The Isthmian Canal Commission," and which was composed of the following members: Rear-Admiral John C. Walker, U. S. N. (retired); Hon. Samuel Pasco; George S. Morison; Lieutenant-Colonel Oswald H. Ernst, Corps of Engineers, U. S. A.; Lewis M. Haupt, C. E.; Alfred Noble, C. E.; Colonel P. C. Hains, Corps of Engineers, U. S. A.; Wm. H.

Burr, C. E.; Prof. Emory R. Johnson. The Commission made an examination of the New Panama Canal Company's project, both in Paris and on the Isthmus, and then proceeded to ascertain upon what terms and conditions the property and rights of the Company might be transferred to the United States, for the law under which the Commission was acting forbade the consideration of government support to a private enterprise. The Republic of Colombia having signified its willingness to consent to the alienation of the concession, it only remained for the Commission to learn the purchase price in order to make its report to the President. There was considerable delay and some misunderstanding about this last detail. The Company was naturally reluctant to submit a definite figure to a body which "had no authority to accept or reject any terms," but proposed instead to make a tentative offer subject to an itemized valuation and arbitration where necessary. To this the Commission would not listen, but insisted upon a statement of the Company's price in a lump sum without reservation.

THE REPORT OF THE COMMISSION FAVORS THE NICARAGUA ROUTE.

The report of the Isthmian Canal Commission was presented to the President in November, 1901. It discarded altogether the detailed memorandum of

valuations submitted by the Company and briefly declared that the "total amount for which the Company offers to sell and transfer its canal property to the United States" is $109,141,500. The value set upon it by the Commission was $40,000,000. It needs no extensive calculation to determine that this was an underestimate, even when due allowance is made for the usual depreciation of second-hand property. It will be remembered that the receiver of the old company valued the assets that passed into his hands at about $90,000,000, and several millions had been expended in a judicious manner by the new company.

The report closed with the following recommendation: "After considering all the facts developed by the investigations made by the Commission and the actual situation as it now stands, and having in view the terms offered by the New Panama Canal Company, this Commission is of the opinion that 'the most practicable and feasible route' for an Isthmian canal, to be 'under the control, management, and ownership of the United States' is that known as the Nicaragua route."

THE FRENCH COMPANY MEETS OUR BID.

When this finding became known at Paris the directors of the New Panama Canal Company immediately resigned and at a general meeting of stockhold-

ers held in the last days of the year it was decided to meet the terms of the Commission's estimate. Accordingly an offer to sell out all assets, rights, and interests for the sum of $40,000,000 was telegraphed, the owners realizing that with only one possible purchaser and the certainty of the property becoming practically valueless unless taken by that purchaser, no alternative existed. The Company's change of base impelled the Commission to make a supplementary report, in which it stated that " the unreasonable sum asked for the property and rights of the New Panama Canal Company when the Commission reached its former conclusion overbalanced that route, and now that the estimates by the two routes had been nearly equalized the Commission can form its judgment by weighing the advantages of each and determining which is the more practicable and feasible. . . . After considering the changed conditions that now exist, the Commission is of the opinion that 'the most practicable and feasible route' for an Isthmian canal to be 'under the control, management, and ownership of the United States' is that known as the Panama route."

THE SENATE INVESTIGATES THE QUESTION OF ROUTE.

In the meanwhile, and before the Isthmian Canal Commission had filed its report, an ill-considered bill had been passed by the House, authorizing the Presi-

dent to secure a concession from Nicaragua and to proceed at once to the construction of a waterway by that route. Fortunately the Hepburn Bill was not hastily disposed of in the Senate. The matter was thoroughly investigated in committee and extensively debated in the chamber. The weight of engineering opinion was overwhelmingly in favor of the Panama route, but, perhaps, the most effective statement in its favor was delivered by Senator Hanna, who had made a close personal investigation of the question. A series of practical enquiries submitted by him to eighty shipowners, shipmasters, officers and pilots engaged in operating the most important intercontinental steamship lines and sailing vessels elicited replies which were without exception strongly in favor of the Panama route. More than ten per cent of these emanated from persons interested in sailing ships and familiar with the navigation of them, a result especially significant in view of the fact that one of the very strongest objections advanced against the more southerly location is its assumed disadvantage to sailing craft.* The debate in the Senate was followed by the passage in both branches of Congress of the Spooner Bill. This measure authorized the President to acquire the rights and property of the New Panama Canal Com-

* Full details of this interesting information will be found in the Congressional Record, June 9, 1902.

pany for a sum not to exceed $40,000,000 and to secure by treaty with the Republic of Colombia the perpetual control of the territory needful for operating the canal; it also provided for the prosecution of the work by an Isthmian Canal Commission consisting of seven members to be appointed by the President.

We have already recited briefly the incidents of the imbroglio that followed the failure of the Colombian Legislature to ratify the Hay-Herran Treaty and culminated in the independence of Panama. Sufficient has been said to show how nearly the American people came to being committed to the Nicaragua route. What, in such an event, would have been the actual outcome it is impossible to conjecture, but there is ample ground for the belief that the undertaking would have proved more hazardous, more difficult, and less satisfactory when completed, than the Panama project.

It will be convenient at this point to consider briefly the most important features of difference between the two routes. In the first place, the verified data upon which to work is very much greater in the case of Panama, not to mention the fact that a considerable proportion of the task has already been accomplished at that point. In fact the Nicaragua project is still a mass of theory which application might prove to be infinitely erroneous, whilst at Panama the stage of uncertainty has been virtually

passed and the operation presents definite and calculable tasks.

THE NICARAGUAN ROUTE COMPARED WITH THAT OF PANAMA.

The American Isthmus does not contain a single natural harbor on the Nicaraguan coast. A satisfactory approach to a canal might be excavated upon the Pacific side, but the Atlantic littoral offers no such facility. The harbor of Greytown, which was once a good one, has long since been closed by the formation of banks whose material is constantly carried down by the San Carlos and Serapiqui Rivers. These obstructions could be cleared, but only at great expense and the maintenance of the necessary channel would involve incessant dredging. At Panama, an excellent entrance is available at either end of the canal.

Whilst both routes lie within the zone of seismic disturbances, there is no recorded convulsion, nor any physical evidence of one, in the Isthmus of sufficient force to have seriously damaged a lock level canal, much less one upon the sea level. Nicaragua, on the other hand, presents volcanic features, including Lake Nicaragua itself, which betoken tremendous upheavals in the past. The earthquake that occurred in that region in 1844 must have caused great destruction to a canal had one been in existence at

the time, as well as to the shipping on it. The proposed line passes close to the active volcano Ometepe, which was in violent eruption as late as 1883. The great volcano, Momotombo, on the edge of Lake Managua, after fifty years of inactivity, burst out with great violence in the month of February, 1905. This eruption was preceded by earthquakes.

NICARAGUAN ROUTE PRESENTS MANY EXTRAORDINARY DIFFICULTIES.

The region traversed by the Nicaraguan route is subject to strong winds and heavy rainfall, which would militate against the safe navigation of a canal. The latter preventing clear observation would tend to delay or prevent passage at night. It is true that Panama is also subject to heavy rainfall, but it is neither so continuous nor so great as upon the Atlantic coast of Nicaragua, which has no definite dry season. Moreover, any delays occasioned from this cause would be of shorter duration and of less consequence in Panama owing to the difference in length of passage.

Serious difficulties in the case of the Nicaragua construction would be created by the San Juan River, which may be considered as at least equal to those involved in the regulation of the Chagres. The course of the former stream is extremely tortuous, and expert opinion holds that it would be impossible

to reduce it to a safe curvature. General Abbott says: "This long river route, exceeding in length the entire distance from ocean to ocean by the Panama line, must remain subject to the combined effects of strong winds, sharp curvature, and longitudinal and cross currents, to say nothing of the obscuration due to heavy rainfall. It may well be doubted whether any system of artificial lighting could render night transit safe for large ships, and without it delays and possible congestion could hardly be avoided." A popular idea prevails that the Nicaragua route offers a great advantage in the seventy miles of lake section, but this is fallacy. Something like one-half of the distance is over bottom that presents a similar problem to that encountered at Lake Menzeleh in the construction of the Suez Canal, to wit, the opening and maintenance of a channel through soft mud. The Isthmian Canal Commission estimated the cost of this portion of the operation at $8,000,000. Even when made, this expensive and difficult channel would be a source of frequent danger, for Lake Nicaragua is subject to violent storms, during which there would be serious liability of vessels grounding. To quote General Abbott: "It remains to refer to what from an engineering point of view would be perhaps the most serious objection to the Nicaragua route if completed and opened to traffic. This would be the risk of longer or shorter interruptions liable to result

from the complicated systems of water supply in seasons of drought of long duration; and the lake lies in a district where they are far from uncommon. It has been claimed that a vast lake about 3,000 square miles in extent must furnish an ideal source of supply, but the matter will bear a little examination.

CONTROL OF LAKE NICARAGUA A SERIOUS PROBLEM.

By the dam on the lower San Juan river the channel of the present stream would be transformed into an arm of the lake, maintained sensibly at the same level, and through this arm all shipping must pass, the depth of water depending wholly on the stand of the lake. This stand is now subject to a natural oscillation of about 13 feet. Under the projected conditions the entire outflow must pass over the dam at a distance of 50 miles from the main lake, and if the level is allowed to rise above the present high water stand, valuable lands under cultivation on the west shore of the lake would be flooded and claims for damages would result. On the other hand the bed of the river is crossed by many ledges of rock, and the cost of excavation fixes a limit to the depth economically practicable. . . . The level of the lake must be held approximately between 111 feet and 104 feet above tide and the bed of the present river must be excavated sufficiently to afford a sailing depth of 35 feet at all times. But the records

establish that years of high lake and years of low lake follow in no regular succession. As it is impossible to provide a reserve sufficient to control the level of an immense body of water 3,000 square miles in extent, the regulation of this vital element must be left to the foresight and good judgment of the operator controlling the outflow of the dam. . . . Carelessness or bad judgment on the part of the operator at the dam, or an abnormal season, might therefore involve the stoppage of traffic for an indefinite period. A really desirable canal should be subject to no such contingency."

THE CONDITIONS AT PANAMA ARE THOROUGHLY UNDERSTOOD.

The work of construction will be carried on at Panama with very much greater facility than it possibly could at Nicaragua. In the former location the Panama Railroad and the tracks to the dumps will afford ideal facilities when the latter are put in a satisfactory condition. The Isthmian Canal Commission called attention to some of the difficulties in this respect that might be expected at Nicaragua. The forty mile stretch between Greytown and the San Juan is a swamp throughout, and as one of the members of the Commission stated: "There are no roads in it. You cannot make any roads except by hauling in material to make them. . . . There

is a very uncertain element as to how much timber you will find to interfere with your dredges while working in that swamp."

The Nicaragua route shows some savings in distances between important shipping points as measured upon the map, but these would almost certainly be made up for by the much shorter time of passage through the Panama Canal.

It must be borne in mind that the decision of the Isthmian Canal Commission in favor of Nicaragua was prompted by the price asked by the Company for its interests in the Panama enterprise and that decision was promptly reversed as soon as the Commission's estimate was accepted. As the cost of constructing and maintaining the respective waterways was practically equal in the Commission's opinion, it is evident that the alacrity with which they turned to the Panama proposition when the terms were favorable was due to a conviction of the superior merits of that project. There is not in fact any respectable opinion to the contrary and the support of the Nicaragua route and the antagonism of the Panama enterprise in Congress and elsewhere is not based at all upon scientific or utilitarian considerations but has its existence in a desire to conserve certain commercial interests.

VIII.

PANAMA.

THE AMERICAN ENTERPRISE.

United States Authority in Colon and Panama — The Price of the Concession — The Canal to be Neutral Forever — Instructions Regarding the Inhabitants of the Zone — Attitude of the United States Towards Panama — A Futile Revolutionary Movement — The Commission Visits the Isthmus — The Plan of the Walker Commission — The Objections to the Commission — Wallace Resigns and Stevens Steps In — The President's Address to the Consulting Engineers — A Disappointing Conclusion — Consideration of the Rival Projects.

The Hay-Bunau-Varilla Treaty was negotiated between the respective representatives of the United States and Panama in the autumn of 1903 and fully ratified February, 1904. The most important features of this convention are as follows:

Article 1. "The United States guarantees and will maintain the independence of the Republic of Panama."

Article 2. "The Republic of Panama grants to the United States in perpetuity the use, occupation and control of a zone of land, and land under water

for the construction, maintenance, operation, sanitation and protection of said canal, of the width of ten miles, extending to the distance of five miles on each side of the centre line of the canal to be constructed; the said zone beginning in the Caribbean Sea three marine miles from mean low-water mark and extending to and across the Isthmus of Panama into the Pacific Ocean to a distance of three marine miles from mean low-water mark, with the proviso that the cities of Panama and Colon and the harbors adjacent to said cities, which are included within the boundaries of the zone above described, shall not be included within this grant . . . The Republic of Panama further grants in like manner to the United States in perpetuity all islands within the limits of the Zone above described and, in addition thereto, the group of small islands in the Bay of Panama, named Perico, Naos, Culebra and Flamenco."

Article 3. "The Republic of Panama grants to the United States all the rights, power, and authority within the Zone mentioned and described in Article 2 of this agreement . . . which the United States would possess and exercise if it were the sovereign of the territory within which said lands and waters are located, to the entire exclusion of the exercise by the Republic of Panama of any such sovereign rights, power or authority."

Article 6 provides for compensation to private

property owners, by the United States, for any damage to private property occasioned by the canal operations and for the assessment of such compensation by arbitration.

UNITED STATES AUTHORITY IN COLON AND PANAMA.

Article 7. " . . . The Republic of Panama agrees that the cities of Panama and Colon shall comply in perpetuity with the sanitary ordinances, whether of a preventive or curative character, prescribed by the United States and, in case the Government of Panama is unable, or fails in its duty, to enforce this compliance by the cities of Panama and Colon with the sanitary ordinances of the United States, the Republic of Panama grants to the United States the right and authority to enforce the same.

" The same right and authority are granted to the United States for the maintenance of public order in the cities of Panama and Colon and the territories and harbors adjacent thereto in case the Republic of Panama should not be, in the judgment of the United States, able to maintain such order."

Provision is made in this article for the reimbursement of the United States for any outlay it may make, under the discretionary authority referred to above, in " works of sanitation, collection and disposition of sewage, and distribution of water, in the cities of Panama and Colon."

Article 9. "The United States agrees that the ports at either entrance of the canal and the waters thereof, and the Republic of Panama agrees that the towns of Panama and Colon shall be free for all time, so that there shall not be imposed, or collected, custom-house tolls, tonnage, anchorage, light-house, wharf, pilot, or quarantine dues, or any other charges, or taxes of any kind upon any vessel using, or passing through the canal, or belonging to, or employed by, the United States, directly or indirectly, in connection with the construction, maintenance, operation, sanitation and protection of the main canal, or auxiliary works, or upon the cargo, officers, crew, or passengers, of any such vessels, except such tolls and charges as may be imposed by the United States for the use of the canal and other works, and except tolls and charges imposed by the Republic of Panama upon merchandise destined to be introduced for the consumption of the rest of the Republic of Panama, and upon vessels touching at the ports of Panama and Colon and which do not cross the canal."

THE PRICE OF THE CONCESSION.

Article 14. "As the price of compensation for the rights, powers, and privileges granted in this convention by the Republic of Panama to the United States, the Government of the United States agrees to pay to the Republic of Panama the sum of ten million dollars ($10,000,000) in gold coin of the

United States on the exchange of the ratification of this convention and also an annual payment, during the life of this convention, of two hundred and fifty thousand dollars ($250,000) in like gold coin, beginning nine years after the date aforesaid. . . ."

THE CANAL TO BE NEUTRAL FOREVER.

Article 18. "The canal, when constructed, and the entrances thereto, shall be neutral in perpetuity, and shall be open upon the terms provided for by section 1 of article three of, and in conformity with all the stipulations of, the treaty entered into by the Governments of the United States and Great Britain on November 18, 1901." *

In accordance with the provisions of the Spooner Bill, the President appointed a commission of seven members to prosecute the canal operations. They were: Rear-Admiral John G. Walker, U. S. N. (retired), Chairman; Major-General George W. Davis, U. S. A. (retired), Governor of the Canal Zone; William Barclay Parsons, C. E.; William H. Burr, C. E.; Benjamin M. Harrod, C. E.; Carl E. Grunsky, C. E.; Frank J. Hecker. John F. Wallace, an engineer of experience and ability, was appointed Engineer-in-Chief, and Surgeon-Colonel W. C. Gorgas, of the United States Army, whose splendid rec-

*The reference is to the Hay-Pauncefote Treaty, which was designed to facilitate the construction of the Panama Canal.

ord in Cuba marked him as pre-eminently fitted for the task, was placed in charge of the Sanitary Department.

In a letter dated May the ninth, 1904, the President directed the Honorable William H. Taft, Secretary of War, to assume supervision of the work of the Isthmian Canal Commission. The same document defines the duties of the Commission, which are, in general, to make all needful regulations for the government of the Zone; and "to make, or cause to be made, all needful surveys, borings, designs, plans, and specifications of the engineering, hydraulic, and sanitary works required and to supervise and execute the same."

INSTRUCTIONS REGARDING THE INHABITANTS OF THE ZONE.

This letter goes on to instruct the Secretary that "the inhabitants of the Isthmian Canal Zone are entitled to security in their persons, property, and religion, and in all their private rights and relations. They should be so informed by public proclamation. The people should be disturbed as little as possible in their customs and avocations that are in harmony with principles of well-ordered and decent living.

"The municipal laws of the Zone are to be administered by the ordinary tribunals substantially as they were before the change. Police magistrates and jus-

tices of the peace and other officers discharging duties usually devolving upon these officers of the law, will be continued in office if they are suitable persons. . . . The laws of the land, with which the inhabitants are familiar, and which were in force on February 26, 1904, will continue in force in the Canal Zone and in other places on the Isthmus over which the United States has jurisdiction until altered or annulled by the said Commission," but the principles of government set forth in the Constitution of the United States are to be observed in the administration of the Zone.

In a later letter to the Secretary, the President makes an important declaration of the broader policy of the United States towards the Republic of Panama as follows:

ATTITUDE OF THE UNITED STATES TOWARDS PANAMA.

"The United States is about to confer on the people ~~of the State~~ of Panama a great benefit by the expenditure of millions of dollars in the construction of the canal: but this fact must not blind us to the importance of so exercising the authority given us under the treaty with Panama as to avoid creating any suspicion, however unfounded, of our intentions as to the future. We have not the slightest intention of establishing an independent colony in the middle ~~of the State~~ of Panama, or of exercising any

greater governmental functions than are necessary to enable us conveniently and safely to construct, maintain, and operate the canal under the rights given us by the treaty. Least of all do we wish to interfere with the business and prosperity of the people of Panama. However far a just construction of the treaty might enable us to go, did the exigencies of the case require it, in asserting the equivalent of sovereignty over the Canal Strip,* it is our full intention that the rights which we exercise shall be exercised with all proper care for the honor and interests of the people of Panama. The exercise of such powers as are given us by the treaty within the geographical boundaries of the Republic of Panama may easily, if a real sympathy for both the present and future welfare of the people of Panama, is not shown, create distrust of the American government."

It is not our purpose to enter into a discussion of the political aspects of the treaty, but a careful reading of the portions which have been reproduced will give an idea of the great scope of this convention. To draw attention to but one direction in which its potency extends, the provision for the maintenance of order by the United States in the cities of Colon and Panama is a practical preventive of future revolution in the Republic.

* See article 3, of the treaty quoted above.

At the close of the year Secretary Taft visited the Isthmus and entered into an agreement with President Amador, covering several supplementary matters of importance. A tariff adjustment, satisfactory to the Panamans, was effected. It was arranged that only supplies for the canal, and goods in transit, were in future to be entered at the Zone ports, thus assuring the Government of Panama of all customs receipts and port dues. The Republic agreed to reduce its tariff from fifteen to ten per cent, except upon wines and alcohol, and to place its postal rates upon the two-cent basis. Panama also agreed to adopt the gold standard, a very necessary measure for the welfare of that republic, as well as for the facility of transactions between the two nations. At the time this understanding was arrived at, the Colombian currency had become so debased that a five-dollar bill was exchangeable for an American nickel, and there was one cent change due at that.

A FUTILE REVOLUTIONARY MOVEMENT.

Just before the arrival of Secretary Taft, General Huertas had planned one of the puny revolutions which have furnished librettists with inexhaustible material. He had mobilized the army of 182 half-clad men and boys, with the design of subverting the Amador government. The threat of calling upon

half a dozen American marines who happened to be in the city with their side-arms on, induced him to give up the idea. He was placed upon the retired list and the army of the Republic was disbanded.

At a banquet given in his honor by the Panaman President the Secretary delivered a timely homily on the subject of revolutions and urged upon his auditors the necessity of the government preserving the rights of the minority. The speech, which was in the nature of a friendly warning and an intimation that the United States expected the Republic to refrain from any revolutionary disturbances in the future, was well received by the representatives of both political parties, and doubtless had a salutary effect.

THE COMMISSION VISITS THE ISTHMUS.

The Canal Commission arrived at the Isthmus in April, 1904. The only work in progress at the time was the excavation of the Culebra Cut, where a few French machines were employed with a force of about seven hundred men. Owing to the long lapse of time since the New Panama Canal Company ceased operations, a chaotic condition prevailed along the entire line of the canal and the plant and equipment transferred by that Company was in such a deteriorated and scattered state as to require months for its collection and repair. Whilst the task of

straightening up was being carried out Engineer Wallace tested some American steam excavators and established important data as to units of cost and expenditure of time. Meanwhile the Commission proceeded, by means of new surveys and examinations, to gain such information as might afford a satisfactory basis for the ultimate plans. As has been stated, the French companies performed a great deal of accurate scientific work along the same lines, but much of the data secured from them needed to be modified in order to bring it into harmony with the more extensive scheme of the American project. The Commission was not restricted by the limitations which governed the plans of the purely commercial enterprises, and whilst its work was entirely of a tentative nature, a waterway much larger than any contemplated by the French companies was a foregone conclusion.

THE PLAN OF THE WALKER COMMISSION.

The Commission formulated a plan for a lock canal at an 85-foot level with a dam at Bohio and a lake 38.5 square miles extending from that point to Obispo. The Commission rejected the sea-level plan, prefacing its conclusion with the following statement: "If a sea-level canal be constructed, either the canal itself must be made of such dimensions that maximum floods, modified to some extent

by a reservoir in the Upper Chagres, could pass down its channel without injury, or independent channels must be provided to carry off these floods. As the canal lies in the lowest part of the valley, the construction of such channels would be a matter of serious difficulty, and the simplest solution would be to make the canal prism large enough to take the full discharge. This would have the advantage, also, of furnishing a very large canal, in which navigation under ordinary circumstances would be exceptionally easy. It would involve a cross section from Obispo to the Atlantic, having an area of at least 15,000 square feet below the water line, which would give a bottom width of at least 400 feet. The quantity of excavation required for such a canal has been roughly computed, and is found to be about 266,228,000 cubic yards. The cost of such a canal, including a dam at Alhajuela and a tide lock at Miraflores, near the Pacific end, is estimated at not less than $240,000,000. Its construction would probably take at least twenty years."

The investigations of the Commission were necessarily directed chiefly to the various suggestions for the control of the Chagres. The question had to be considered from the point of view of a sea level canal as well as that of a waterway with locks. In the former case the flood waters of the river, if admitted into the canal, would create damaging currents and carry in heavy deposit

tensive dredging. The various dam projects were examined by the Commission as well as the plans of the French Companies for diverting the river through a tunnel to the Pacific Ocean.

Before the Commission closed the first year of its existence the question of its efficiency and adaptability to the work in hand was widely raised. Secretary Taft, upon his return from the Isthmus in December, 1904, had expressed to the President an opinion that the Commission, whilst it had "made as much progress in the necessary preparations for the building of the canal as could be expected in the short time since its appointment," was unwieldy and so constituted as to render difficult the apportionment of specific work and responsibility among its members. Chief Engineer Wallace complained that his plans were repeatedly changed and that he was hampered in the effort to carry them out.

THE OBJECTIONS TO THE COMMISSION.

In a message sent to Congress on the 13th of January, 1905, President Roosevelt plainly expressed his objections to the existing arrangement. He asked for "greater discretion in the organization of the personnel" to be employed in the management of the enterprise.

"Actual experience has convinced me," he said, "that it will be impossible to obtain the best and

most effective service under the limitations prescribed by law. The general plans for the work must be agreed upon with the aid of the best engineers of the country, who should act as an advisory or consulting body. The consulting engineers should not be put upon the Commission, which should be used only as an executive instrument for the executive and administrative work. The actual work of executing the general plans agreed upon by the Commission, after receiving the conclusions of the advising engineers, must be done by an engineer in charge; and we now have an excellent engineer." The President went on to state that the Commission should consist at most of five members and preferably of three.

In response to this message, the House passed a bill to abolish the Commission and place the government of the Zone and the construction of the canal entirely in the hands of the President, but the measure was defeated in the Senate. Failing Congressional relief the President determined, in his characteristic way, to deal with the situation himself. He secured the resignation of the entire Isthmian Canal Commission and reformed that body, placing the control of affairs definitely in the hands of an Executive Committee composed of three of the seven members required by law to constitute the whole. Each of the executive members had distinct duties assigned to him. Chairman Shonts was placed in charge of the entire enterprise, with powers resemb-

ling those of a railroad president. Engineer Wallace was made field manager, with full control of the construction. Judge Magoon was created Governor of the Canal Zone and United States Minister to Panama.

WALLACE RESIGNS AND STEVENS STEPS IN.

The new arrangement had been in force less than sixty days when the Chief Engineer, for some cause which has never been fully explained, resigned his position. The resignation, coming as it did without warning or adequate explanation, naturally aroused resentment on the part of Secretary Taft, and Mr. Wallace retired from the service under a cloud. The place thus made vacant was promptly and satisfactorily filled by the selection of John F. Stevens, who had been engaged by the War Department to supervise the construction of the new railroads in the Philippines. Mr. Stevens assumed charge of the canal operations in August, 1905.

On the first day of the following month the International Board of Consulting Engineers met in Washington. This body had been formed with the co-operation of several foreign governments for the purpose mainly of examining the principal problems involved in the construction of the canal. The most important matters considered by the Board pertain to the form of the waterway. The members of the

Board are: Henry Hunter, Chief Engineer of the Manchester Ship Canal (nominated by the British Government); Adolph Guerard (nominated by the French Government), Eugene Tincauser (nominated by the German Government), J. W. Welcker (nominated by the Government of the Netherlands), M. L. Quellence, Consulting Engineer of the Suez Canal; Gen. George W. Davis, U. S. A. (retired); Alfred Noble, Chief Engineer of the Pennsylvania Railroad; William Barclay Parsons, formerly of the New York Rapid Transit Commission; William H. Burr, of Columbia University; Frederick P. Stearns, hydraulic engineer of Boston; Gen. Henry L. Abbott, U. S. A. (retired); Joseph Ripley, engineer of the Sault Ste. Marie Canal; Isham Randolph, engineer of the Chicago Drainage Canal. These men are eminently qualified to exercise the important advisory functions entrusted to them, not only by reason of technical knowledge, but also on account of special experience. General Abbott and Mr. Hunter had been members of the *Comité Technique;* General Davis, Mr. Parsons and Professor Burr, of a former Isthmian Canal Commission.

THE PRESIDENT'S ADDRESS TO THE CONSULTING ENGINEERS.

The President addressed the assembled Board at length, explaining that his remarks were to be taken

as suggestions rather than as instructions. "I hope," he said, "that ultimately it will prove possible to build a sea-level canal. Such a canal would undoubtly be best in the end, if feasible, and I feel that one of the chief advantages of the Panama Route is that ultimately a sea-level canal will be a possibility. But, while paying due heed to the ideal perfectibility of the scheme from an engineer's standpoint, remember the need of having a plan which shall provide for the immediate building of the canal on the safest terms and in the shortest possible time.

"If to build a sea-level canal will but slightly increase the risk, then, of course, it is preferable. But if to adopt a plan of a sea-level canal means to incur hazard, and to insure indefinite delay, then it is not preferable. If the advantages and disadvantages are closely balanced I expect you to say so.

"I desire also to know whether, if you recommend a high-level multi-lock canal, it will be possible after it is completed to turn it into, or substitute for it, in time, a sea-level canal, without interrupting the traffic upon it. Two of the prime considerations to be kept steadily in mind are: 1. The utmost practicable speed of construction. 2. Practical certainty that the plan proposed will be feasible; that it can be carried out with the minimum risk."

After a thorough study of the maps and documents in the possession of the Isthmian Canal Com-

mission, the Board of Consulting Engineers spent three weeks on the Isthmus. Upon the return of the Board to the United States early in December, it was given out that their report would not be signed and submitted until February, or March, of 1906. It was, however, allowed to be known that the final recommendation of the Board would favor a sea-level canal. The majority which reached this decision was made up of the five foreign members, together with General Davis, Professor Burr and Mr. Parsons. The remaining five members, all Americans, advocated a lock canal. This conclusion of the advisory engineers was received with disappointment throughout the country and especially in administration circles.

A DISAPPOINTING CONCLUSION.

The Walker Commission, after detailing the requirements of a sea-level canal, had stated: "Whilst such a plan would be physically practicable and might be adopted if no other solution were available, the difficulties of all kinds, and especially those of time and cost, would be so great that a canal with a summit level reached by locks is to be preferred." It was upon this testimony, arrived at by the ex penditure of much time and a million dollars, th Congress made its appropriation for a lock can The people had formed an idea that it was an

cepted matter, and they were not inclined to be easily reconciled to a contrary decision on the part of a majority of the engineers, no matter how eminent, who were foreigners and therefore might be supposed to have less concern than Americans regarding the cost and delay entailed by following their proposal.

At the present time it is impossible to tell what may be the outcome of the report of the Advisory Board. The body acted in a purely consultative capacity and there is no obligation, implied or otherwise, to heed its recommendations. The President is known to be strongly averse to changing the plans in any manner that would involve serious uncertainty as to money and time that will be required for the completion of the undertaking. The Secretary of War and a majority in Congress are in accord with his sentiments. The law gives him unquestionable authority to proceed with the canal in the way he thinks fit. He may, if he chooses, entirely disregard the advice of the Board as to the form of the waterway and continue the work on the present lines with a view to the completion of the canal with locks. If, on the other hand, the President should adopt the recommendation of the Board it would be necessary for him to secure the endorsement of Congress in the form of a further appropriation to meet the additional cost of sea-level construction. It is probable that the President will formally submit the report of the Board to Congress, accompanied by a

message arguing the desirability of adhering to the lock-level project.

CONSIDERATION OF THE RIVAL PROJECTS.

It is universally admitted that a sea-level canal is the ideal waterway. It would involve few engineering problems of consequence that would be absent from the plans for a lock canal. The two important elements of construction are the same in either case — the control of the Chagres and the passage of the divide. In both cases it would be necessary to provide for one or more dams and spillways to accommodate the flood waters of the river and the diversion of its lower course is also a feature of each project. The construction of a sea-level canal would require a much deeper cut at the Culebra pass and other points, but it might not entail any greater difficulties in excavation than may be expected in digging a lock level, though the task of transportation to the dumps, a very serious one under any circumstances, would be greatly enhanced by the greater excavation.

As to the time that should be estimated for making a waterway at the level of the oceans, expert opinions differ. It is believed that the Board will place it at fifteen years, whilst many authorities are inclined to the belief that twenty would be a more reasonable figure.

HEADQUARTERS OF THE COMMISSION AT PANAMA.

IX.

PANAMA.

THE PLAN OF THE CANAL.

Sea-level Plan Recommended by the Board — The Starting Point of the Canal — Accommodation for the Largest Vessels — The Question of Time — The Great Culebra Cut — The Board's Estimate of Time — Cost of Maintenance — Lock Canal Project of the Minority — The Configuration of the Canal Line — Excavation in the Cut — The Lake and Dam at Gatun — Dimensions of the Dam — Enormous Weight of the Dam — The Advantages of the Gatun Dam — Important Matter of Water Supply — The Summit Level — Lake Sosa — Early Suggestions Adopted — The Gatun Locks — Differences of Opinion as to Type of Canal — The Board Depreciated the "Soo" Canal.

The report of the International Board of Consulting Engineers was transmitted to Congress by the President, February 19, 1906. The report was accompanied by letters of comment and advice from the President, Secretary Taft, Chairman Shonts and Chief Engineer Stevens, all of whom substantially agree in their criticisms and suggestions.

As had been anticipated, a majority of the Board, composed of the following members, recommended the construction of the canal on the so-called "sea-

level": Messrs. Hunter, Tincauser, Guerard, Quellenec, Welcker, being all the foreigners, and the three Americans, Messrs. Davis, Parsons and Burr. The Board made a close study of the question in all its aspects, both at Washington and upon the Isthmus. The plan of a former Isthmian Canal Commission, that of the *Comité Technique,* and several plans submitted by individual engineers, were carefully examined.

SEA-LEVEL PLAN RECOMMENDED BY THE BOARD.

The report is prefaced by a statement of the reasons why a sea-level canal is feasible only in the Panama region. The width of the Isthmus of Panama is less than at any other point that may be considered. It is but thirty-six miles from sea to sea as the crow flies. This is five miles greater than the distance at San Blas, but there an open cut, or, indeed, any kind of canal is impracticable on several accounts. The original summit on the Panama route was no more than 333 feet above the sea, and this is lower than the summit of the divide at any other point on either continent, with the exception of Nicaragua, where a sea-level canal has never been within the bounds of consideration.

The general direction of the Isthmus of Panama is nearly northeast and southwest and the general route for the canal nearly northwest and south-

east. The summit at Culebra lies about nine miles from Panama Bay, and the distance between the point on the northern approach to this summit, where the present elevation on the proposed canal axis is 100 feet above sea level, to the point on the southern approach to Culebra at the same height, is nearly nine miles. Within this distance will be found nearly one-half the total excavation required to make an open channel at the sea level adequate in dimensions and capacity to pass not only the largest existing commercial and naval vessels, but the largest which may be expected to require transfer between the Atlantic and Pacific oceans for many years to come.

For the ultimate construction of the proposed sea-level canal the Board approves in general the alignment adopted by the two French companies, to which later plans have conformed more or less. Some slight changes of direction are, however, recommended for the purpose of reducing curvature and minimizing excavation.

Colon and La Boca are retained as the terminals, but extensive improvements at each entrance are suggested.

THE STARTING POINT OF THE CANAL.

The initial point of the axis of the canal is located about one mile northwest of Manzanillo light. Thence the line runs direct to the mouth of the River

Mindi, where it connects with the centre line of the canal as partially excavated by the Panama Canal Company. From Mindi the proposed line is along the cutting in question nearly as far as Bohio, a distance of 12 miles. The canal first meets the Chagres at Gatun and repeatedly cuts its course between that town and Bohio.

After passing Bohio the ground gradually rises toward the divide. The bed of the Chagres is practically at sea level at Bohio, whilst at Obispo, 14 miles distant, it is 50 feet above sea level. Between these two points the canal follows the general course of the river, coinciding with it or cutting it at many points. At Obispo, or Gamboa, which are less than a mile apart, the trend of the Chagres valley is to the northeast almost at right angles to its former course, but the canal maintains the southeasterly direction followed by it from Colon to Obispo. The project contemplates a dam at Gamboa to control the floods of the Chagres. The waters escaping from the reservoir through regulating sluices would enter the canal prism about a mile below Obispo.

Obispo may be considered the northern entrance to the great cut through the divide; from this point the ground rises abruptly. Between Obispo and Pedro Miguel the greater part of the material to be excavated in accordance with this plan would be rock. A sea-level canal would require a cut to a depth of 373 feet from the original summit. The present

excavation has, however, reached a depth of 160 feet, so that 213 feet would be the maximum of future excavation required for a sea-level canal with a depth of 40 feet. The length of the cut between Obispo and Pedro Miguel is nearly nine miles.

The line of the canal reaches low marshy ground about two miles below Pedro Miguel. Thence to deep water in Panama Bay the Board has adopted a different alignment from that of the French plan. The latter closely conformed to the course of the Rio Grande to its mouth at La Boca. This line avoids a considerable amount of rock excavation, but involves two curves, in order to exclude which the line of the Board takes a straight direction from Miraflores through the Rio Grande swamp. The canal continues in a straight line to and through the saddle between Ancon and Sosa hills, where the tidal lock is to be placed, and thence to deep water off Isla Flamenco. The plan provides for levees from Miraflores to the lock so as to prevent the tidal flow from entering the canal. The French plan required a tidal lock at Miraflores, about five miles from the coast.

ACCOMMODATION FOR THE LARGEST VESSELS.

The proposed dimensions of the sea-level canal are calculated to facilitate the passage of the largest vessels afloat and to allow for some increase of size and

draft in the future. It is believed by the Board that a canal constructed on the plan suggested might be traversed by a ship of 90 feet beam and 38 feet draft at a speed of four or five miles an hour. The largest existing vessels might make six miles an hour and the average craft eight. These speeds would permit of passages ranging from five to ten hours in time.

Summarized, the sea-level canal as recommended by the Board is a channel commencing at the 41-foot contour in Limon Bay, about 5,000 feet northerly of a line between Toro and Manzanillo lights, protected by two converging jetties with a width of opening of 1,000 feet; thence with a straight channel 500 feet in width at the bottom and a depth of 40 feet, protected by a parallel jetty on the west and by Manzanillo Island on the east, to Mindi, whence the land canal commences. This canal is designed with a depth of 40 feet and a bottom width of 150 feet in earth, with side slopes adjusted to the nature of the ground so as to give a surface width of from 302 feet to 437 feet. In rock the section is to be altered so as to have a bottom width of 200 feet and a surface width of 208 feet. At the Pacific end, the canal is to be furnished with a tidal lock located between Ancon and Sosa hills. Beyond this lock a straight channel is to project into the Bay of Panama with a bottom width of 300 feet and extending for a distance of three and three-fourths miles to the 45-

foot contour.* The width adopted for the canal will be sufficient to permit steamers to maintain a speed of six to eight knots per hour, and to allow two ordinary steamers to pass each other on the line of the canal without stopping.

At Gamboa there is to be located a dam, either of masonry or of earth and masonry combined, for the control of the Chagres, and at Corozal, sluices by which, during half the tide period when the level in the Pacific is lower than that in the Atlantic, water can be discharged from the canal into Panama Bay.

The entire length of the line between shores is a little over 40 miles, while the total distance, including harbor channels, is 49.35 miles. The total length of curves is 19.17 miles, leaving 30.18 miles of tangents, or straight stretches.

THE QUESTION OF TIME.

In proceeding to its estimate of the time necessary for the construction of a canal, which "is one of the main elements of the whole question," the Board confidently assumes that its plan is superior to the lock-level project. On this assumption it concludes that "if the work required under the less desirable plan can be finished within ten or twelve years, while that under the more desirable plan would require but

* Contours refer to mean sea level.

two years longer, the small delay in the passage of the first vessel through the waterway might easily be neglected in comparison with the advantages secured under the better plan." The plan involves three great tasks — the installation of the locks, the construction of the dam at Gamboa and the excavation at the summit. The last is considered the controlling factor in the expenditure of time, as it will consume greatly more than any other portion of the work. The final estimate then is based upon a calculation of the length of time necessary to complete the great cut.

THE GREAT CULEBRA CUT.

The Board is of the opinion, derived from a study of the work already accomplished upon the prism, that "from 80 to 100 steam shovels of the most effective type now in use on the Isthmus can be efficiently employed continually on this work after complete organization. It will require from two to two and a half years to install and put in operation this excavating plant. The independent studies by the Board of the arrangement of railroad tracks and of complete systems of attack at both ends of this summit cut completely confirm the conservatism of the evidence given before it. It is as clearly demonstrable as any estimate of rate of progress and time for the completion of any great engineeri

that after the full installation of plant not less than 100 steam shovels may be continuously engaged between Obispo and Pedro Miguel until the amount of work remaining to be done becomes too small to afford space for the operation of the whole plant.

"The Board recognizes that the removal of the material in the summit cut is in reality a problem of transportation. It is a comparatively simple matter to excavate the material within a much shorter time than that allowed for the work, even on the supposition that all of it except the clay near the surface must be shattered by preliminary blasting. The whole difficulty attending this part of the construction of the canal is attached to the removal of the material from the shovels or other excavators to the spoil banks. This problem of transportation is in reality the substance of the problem of building the transisthmian canal, and, in treating this part of the project, the Board realizes and has considered the large amount of railroad track and the extensive transportation organization required for the disposition of the waste material. It is probable, as has been estimated, that not less than three miles of standard track will be required for each shovel employed, making a total of 300 miles of trackage for 100 shovels.

"If it be assumed that 100 shovels are available for continuous work, there being a sufficient surplus above that number undergoing repairs whenever nec-

essary to maintain the working complement, it can be demonstrated that as much as 20,000,000 cubic yards of material classed as rock may be annually removed from the summit cut. This estimate is based upon an average number of working days of not less than 20 per month throughout the year, which is an underestimate on the basis of the experience of the French companies and of that which has accrued since American occupation began in May, 1904. In this estimate the capacity of one shovel is taken as materially less than would be justified by the actual operation of steam shovels in the Culebra Cut during the past year, both in wet and dry seasons. Furthermore, it has been supposed that the working day is to be but eight hours long and that one shift only of laborers would be employed per day, whereas it is perfectly feasible to work two shifts in twenty-four hours during the greater part of the year and possibly during the whole year. Using these estimates for the period of what may be assumed to be the maximum annual output in the Culebra Cut, and allowing at least two and a half years to attain this maximum rate at the beginning of the work and a period of not less than three years for a decreasing output in the more contracted space in the lower portions of the cut during the closing period of the operations, it is found that the entire quantity of 110,000,000 cubic yards of material in the divide can be removed within ten years.

BUILDINGS OF THE ANCON HOSPITAL.

"Although the preceding estimate of time has been based upon ample allowances for the effect of the rainy seasons, for the low grade of labor available on the Isthmus, and for climatic conditions in general, the Board has added about 25 per cent to it for other contingent causes of delay, either similar to those already provided for or of any other character. It is therefore the judgment of the Board that a ship canal on the sea-level plan outlined in this report can be completed within a period of time not exceeding twelve or thirteen years."

ARGUMENT FOR SEA-LEVEL CANAL.

The report goes on to a statement of the reasons for preferring a sea-level canal to one on the lock plan. Many of these reasons are vigorously disputed by the minority section of the Board who have the support of a number of engineers thoroughly conversant with the subject.

The chief argument of the Board for the adoption of its plan is based on the assumption that any type of canal involving lift locks as an essential feature must entail a degree of hazard in the matter of obstructions and accidents that would be absent from a waterway at sea level. A large proportion of the report is devoted to the advancement of this proposition which, as we shall see later, is open to question, to say the least of it. In the opinion of the Board

the "locks constitute a restriction or limit to the capacity for traffic of the waterway in which they are found, i. e., they are in a substantial measure obstructions to navigation. There is a limit to the number of lockages per day which may be made, perhaps not to exceed ten per lock or twenty per pair in any of the lock plans hitherto considered. The maintenance and operation of locks is also expensive.

COST OF MAINTENANCE.

"If of such great dimensions as those considered necessary by the Board under the Spooner Act, they require the installation, maintenance, and operation of an extensive power plant for the working of the gates. It is not easy to estimate what the annual cost of maintenance, including renewals and operation, of these would be, but, using the estimates of the Isthmian Canal Commission of 1899–1901, it is probable that the annual cost of operation of the six locks contemplated in the project brought before the Board would be about $525,000. This annual charge capitalized at three per cent would make a sum of $17,500,000 to be added to the cost of the lock canal. The corresponding item in the sea-level plan would be the capitalized annual cost of operating the tidal locks near Panama.

. . . . . .

"It has already been stated as the opinion of the Board that the time required for the construction of the Panama Canal with a summit level at 60 feet above mean sea level will at best be only two years less than required for the construction of the sea-level canal. But, as affecting this question of time, it should be observed that accidents during construction leading to an extension of the time required to complete the canal would be more likely to occur in the more numerous structures involved in the building of the lock canal than in the works of the sea-level canal. It has further been shown that the difference in cost between the two plans will not exceed about $71,000,000 in favor of the former, which must be reduced by the capitalized cost of the maintenance and operation of locks and by the cost of the overflowed lands."

The report closes with an expression of the belief of the Board that "the essential and the indispensable features of a convenient and safe ship canal at the American Isthmus are now known; that such a canal can be constructed in twelve or thirteen years' time; that the cost will be less than $250,000,000; that it will endure for all time."

The minority report was signed by Messrs. Noble, Abbot, Stearns, Ripley and Randolph. The project proposed by it is set forth more exhaustively and with greater precision than is the plan recommended by the majority.

The minority "believe a lock canal the better one for the United States to construct, for the following reasons: 1. Greater capacity for traffic than afforded by the narrow waterway proposed by the Board. 2. Greater safety for ships and less danger of interruption to traffic by reason of the wider and deeper channels which the lock canal makes possible at small cost. 3. Quicker passage across the Isthmus for large ships or a large traffic. 4. Materially less time required for construction. 5. Materially less cost." It will be noted that the most important of these considerations are precisely the advantages which the Board claims for the sea-level over the lock type of waterway, but, it may be added, the minority has made out a strong enough case on its side to gain the support of the Canal Commission and of the Administration.

LOCK CANAL PROJECT OF THE MINORITY.

The project is a modification of that proposed by the Isthmian Canal Commission of 1899–1901, which was itself based upon a number of preceding plans. The summit level is practically the same in each case. The minority plan provides for greater dimensions than did that of the Commission, and recommends a dam at Gatun in place of that proposed at Bohio and places the terminal lock at Sosa instead of at Miraflores.

A brief description of the configuration of the land along the canal line will conduce to a clearer understanding of the plan proposed by the minority, which may safely be assumed to be that on which the waterway will be ultimately built.

THE CONFIGURATION OF THE CANAL LINE.

The Island of Manzanillo, off the northwestern point of which the harbor entrance to the canal is located, lies to a considerable extent below the level of the ocean. Whilst the harbor entrance to the channel is located off the northwestern point of the Island of Manzanillo, it is at the mouth of the River Mindi, four and a half miles beyond, that the land canal begins. Here the surface of the ground is slightly above the ocean level. Three miles farther on it attains a height of 85 feet in the vicinity of Gatun. It then dips abruptly and from Gatun to Obispo, a distance of 23 miles, lies at a general elevation of 40 feet above the mean level of the Atlantic. Obispo may be called the northern entrance to the divide and Pedro Miguel its southern exit. The Culebra Cut, which extends between these points, is at present at an elevation of 173 feet, being 160 feet lower than the original crest. The cut as defined extends approximately from point 31 to point 39.* From Pe-

* See profile map of the Canal line.

dro Miguel to Sosa Hill, on the shore of Panama Bay, is a stretch of six miles, throughout which the land hardly anywhere exceeds an elevation of more than 10 feet above the mean level of the Pacific Ocean. From Sosa Hill to the 7-fathom contour in the Bay, near Isla Perico where the channel terminates at point 49.72, is a distance of about five miles. Thus we have the canal line divided into four distinct sections: 1. The Atlantic Ocean Level, length 7.15 miles. 2. The Summit Level, length 31.64 miles. 3. The Pedro Miguel-Sosa Level, length 5.47 miles. 4. The Pacific Ocean Level, length 4.23 miles. The sum of these sections gives us an aggregate of 48.49 miles, and if we add to this the total measurements of the locks, we shall have 49.72 miles, being the exact length of the axis of the canal.

The project of the 85-foot lock-level waterway is as simple as it is practicable. It consists briefly in damming the Chagres on one side of the divide and the Rio Grande on the other, and so forming two large artificial lakes. One of these will extend the full length of Section 2 and the other of Section 3. The two outer sections will be tidal channels at sea level.

A glance at the profile map will show that in order to secure a depth of 45 feet throughout the canal, under this plan very little dredging and excavation will be required as compared with the amount necessary to the construction of a waterway at sea level.

LABORERS' QUARTERS ALONG THE CANAL LINE.

The former has its bottom at elevation 40 above sea level; the latter at 40 below. It is, however, only where the ground stands at elevation 40 or over, that there will be a clear saving of 80 feet in this respect. In places, such as the terminal channels, the depth of excavation requisite will be the same in each case and the fact that the lock plan contemplates a much broader channel through much of the course tends to decrease the disparity in the respective excavations.

EXCAVATION IN THE CUT.

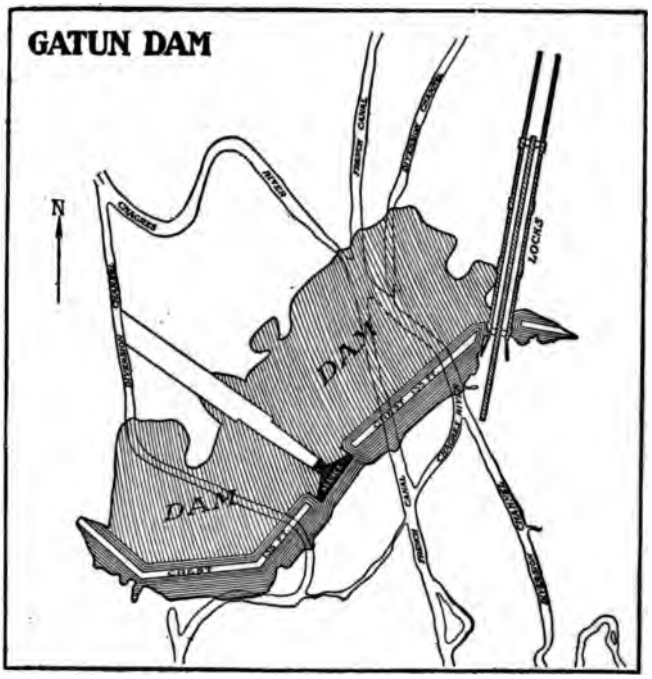
Between points 8 and 25 there is practically no elevation exceeding 40, and consequently the natural bottom is at or below the desired level. From San Pablo, point 25, to Obispo, point 31 plus, some small material must be removed, but the work involved will be insignificant. The Cut must be reduced by 133 feet to reach the standard level of the bottom of the lock canal. For the sea-level construction it would be necessary to go 80 feet deeper and the extra depth would be through hard rock requiring to be blasted. In Lake Sosa, which will have a water level at 55 feet, no work worth mentioning will be needed to secure the 45-foot depth, because, as has been stated, the ground lies, with insignificant exception, below elevation 10.

In general the minority approves the Board's plans for the Colon entrance, but suggests that the break-

miles in extent. The minority report presents forcible reasons for substituting the Gatun dam. The project when put into effect will transform the canal prism into two lakes practically extending from coast to coast and joined by the channel through the divide. The conclusions of the minority in this matter are based upon a great number of borings and recent topographical surveys. From these it is apparent that Gatun affords not only an entirely suitable location for the dam but also an excellent site, on the neighboring high ground, for locks. Investigation along these lines seems to establish the fact, which is of the greatest importance, that there would be no appreciable seepage under the dam, owing to the practically impervious nature of the material on which it would rest. In places where material of a somewhat less favorable character is found, it is covered with a blanket of practically impervious material 200 feet in thickness. The plans for the dam contemplate a structure of earth which could not be destroyed by the forces of nature and "could only be destroyed by making excavations which would require a large force working for a long time."

DIMENSIONS OF THE DAM.

The top of the dam is 100 feet wide and stands 50 feet above the normal level of the lake; at water level the distance through the dam is 374 feet, and



GATUN DAM.

The embankment, with its great sluice, extends across the map, with the Locks upon the extreme right.

The Panama Railroad will be diverted to a line east of the Locks and will cross an arm of Lake Gatun over a causeway, via Tiger Hill, to dry ground near Ahorca Lagarto.

at sea level the corresponding distance is 2,625 feet, or one-half mile. For the upstream slope, rock obtained from canal excavations will be dumped as riprap, with a special thickness about the level at which the dam will be exposed to wave action. Above elevation 80 the dam will be built of impervious material to a few feet above the water level, and the higher portions will be made of whatever materials may be most convenient, it being expected that spoil from the Culebra Cut will be used to a great extent.

ENORMOUS WEIGHT OF THE DAM.

A dam such as the one proposed is enormously heavy, the weight upon its foundation being about one ton per square foot for each 20 feet in height of embankment. Under the highest part of the embankment the pressure would be six and one-half tons per square foot. It is believed that this dam will be earthquake proof. It is designed to be very much stronger than the greatest existing earth dams in the world, those of San Leandro and Pilarcitos, connected respectively with the waterworks systems of Oakland and San Francisco.

The total length of the dam from the locks to the westerly end is 1,700 feet. About midway in its length is rising ground through which it is proposed to excavate a diversion channel to carry the Chagres

during the construction of the dam. The regulating works, which will be described hereafter, are to be located on each side of the diversion channel and partly within it. On either flank of the rising ground to which reference has been made, and extending from it westerly to the high ground and easterly to the locks at the back of Gatun, there will be great earth embankments of the cross section already described, which will together contain 21,200,000 cubic yards of material. The westerly embankment will cross a French diversion channel. The easterly embankment will cross the French canal and the Chagres.

The regulating works are thus designed. The central 150 feet of their length, which will be built from the bottom of the diversion channel, is to be a solid mass of concrete, having its crest at elevation 69. On the top of the crest, piers eight feet in thickness, grooved for Stoney sluice gates, are to be built, 38 feet from centre to centre, having clear openings of 30 feet. The gates, as proposed, are almost exact counterparts of the gates provided for controlling the flow from the lower end of the Chicago Drainage Canal. For the whole length of the regulating works the design is the same as for the central portion, except that the concrete rests upon the surface of the rock or upon excavations made in the rock. The water passing through the central sluices will flow directly out through the diversion channel to the

Chagres. The regulating works are capable of discharging 140,000 cubic feet per second when the water of the lake is no more than one foot above the normal level.

Despite the great quantity of material to be placed in the Gatun dam, the report shows that a large saving will be effected by the structure. The project of the Commission included a dam at Bohio, a spillway, an outlet from the Pena Blanca swamp, diversion channels for the Chagres and Gatun rivers, and a stretch of canal between Gatun and Bohio. All these works, which were estimated to cost $23,640,-221, are avoided by the scheme of the Gatun dam, and its construction, together with a necessary diversion of the Panama Railroad, will be effected with an expenditure of less than $12,000,000. The calculation takes no account of locks, however. The Commission's plan provided for only two locks at Bohio, of comparatively small size. The requirement of the Spooner Act makes it necessary to provide locks of greater dimensions and the minority members of the Board deem it advisable to make the ascent to the 85-foot summit level with three flights. These will cost more than the two proposed for the Bohio dam.

THE ADVANTAGES OF THE GATUN DAM.

"The adoption of Gatun as a site for a dam not only provides for reduced cost and a better lock site,

but, as compared with Bohio, it affords several advantages. The first of these is a large addition to the drainage area tributary to the summit level and to the amount of water available for canal uses, which is of special value during dry seasons; the second is the great increase in the reservoir area, Lake Gatun having three times the area of a lake formed by a dam at Bohio; this permits storing water for the dry season and the reception of floods with a maximum variation of lake level of only about one-half of that taken by the first Isthmian Canal Commission for Lake Bohio. A third advantage is the extension of lake navigation nine and one-half miles toward the Atlantic from Bohio; a fourth is that the Chagres and all its important tributaries will be received into the lake at points so distant from the canal route that no deposit of suspended matter will occur along it, and a fifth is that the water discharged from the lake will enter the Chagres at the point where it finally diverges from the canal so that no diversion channels or heavy protecting embankments will be required along the canal line."

IMPORTANT MATTER OF WATER SUPPLY.

The highly important subject of water supply has been treated by General Henry L. Abbot in a paper which forms an appendix to the report. Recorded measurements of flow covering a period of

fifteen years give 1,250 feet per second during the three driest months. In order to make their calculation entirely safe the minority has accepted 80 per cent of this volume as a basis. The lake can, towards the end of the wet season, be safely raised one foot above the normal level and provision has been made in the plans for drawing the water three feet below this mark. Therefore the equivalent of four feet of depth in the lake, or 12,270,000,000 cubic feet, will be available for water supply purposes in the dry season. This quantity will furnish a steady flow of 1,577 cubic feet per second for ninety days, making the total quantity of water after adding the inflow, 2,577 cubic feet per second. After allowing for evaporation, infiltration, power for operating gates and for lighting, etc., there remains 1,350 cubic feet per second available for lockage.

"To determine the number of lockages which this quantity of water will provide for, the following provisions and assumptions have been made:

"Intermediate gates are to be provided for the locks at Pedro Miguel and Sosa, so as to give a chamber length of 600 feet,* and it is assumed that the intermediate gates will be used for eight-tenths of the lockages. . . . It is further assumed that all ships passing in one direction will use one set of locks and all ships passing in the other another set.

* The full length of locks is 900 feet clear.

On this assumption the same quantity of water is used whether a ship passes through a single lock or through two or three in flight. The lift to the normal level at Pedro Miguel is 30 feet and at Gatun 28.50 feet per lock. The quantity of water required per lockage at Pedro Miguel, on the assumption that intermediate gates will be used eight-tenths of the time, is 22.13 cubic feet per second, and the quantity per lockage at Gatun 29.77 cubic feet per second, making a total of 51.90 cubic feet per second. The net available quantity of water is, as already stated, 1,350 cubic feet per second, and will therefore provide for 26 lockages per day at each lock in the driest season."

When the time comes that a greater number of daily lockages must be provided for there will be no difficulty about compassing the requirement. The Alhajuela dam and reservoir as proposed by the *Comité Technique,* will supply enough water for at least 27 additional lockages per day.

In order to ascertain the amount of tonnage that may be accommodated by the canal as planned, without the contingent Alhajuela addition, the traffic of the Suez Canal has been taken as a basis. The size of the vessels passing through that waterway has steadily increased during the past decade: in 1894 they averaged 2,398, and ten years later 3,163. The system of measuring tonnage at the canal, however, gives figures about one-sixth in excess of Lloyd's

net register. It seems propable that when the traffic at the Isthmus requires 26 lockages per day, in view of the growth in the size of ships and of the fact that two ships of ordinary size can pass through a lock at the same time, the amount of tonnage per lock will be as much as 5,000. On this assumption the canal, as planned by the minority, will accommodate upwards of 47,000,000 tons without the Alhajuela reservoir and twice as much with the aid of its water supply.

THE SUMMIT LEVEL.

Three flights of locks at Gatun will give access to the summit level. These locks will be in duplicate, thereby admitting of the temporary disuse of one flight on account of accident or repairs without serious impediment to traffic. The dimensions of locks throughout the canal will be length clear, 900 feet; usable width, 95 feet; depth over the miter sill, 40 feet.

Of the total length of the lake — 30 miles — 23 miles will be included in the line of the canal. At Gatun, and as far thence as Bohio, the depth will be 75 feet or thereabouts, gradually reducing until at Obispo it will be 45 feet. For a distance of nearly sixteen miles from the Gatun locks the deep portion of the lake will have a width generally exceeding half a mile and, with only a small amount of exca-

vation, a channel may be provided having a width nowhere less than 1,000 feet at the bottom and with a minimum depth of 45 feet. Farther up the lake, as the amount of excavation needed to secure a similar depth increases, the channel will narrow, first to 800 feet for a distance of almost four miles, from San Pablo to Juan Grande, then for about the same distance to 500 feet until Obispo is reached. For one and a half miles, from Obispo to Las Cascadas, the width of the channel at bottom will be 300 feet and through the remaining distance of the Culebra Cut it will be 200 feet. Thus the 23-mile stretch from Gatun to the entrance of the great cut will be through a channel nowhere less than 500 feet wide. This broad waterway will actually furnish lake navigation very similar to that of the chain of small lakes that connects Lake Superior with Lake Huron, and which is styled St. Mary's River. This channel, from 300 to 600 feet in width, is traversed monthly by a tonnage approximating 3,500,000, at a speed which is limited by regulation to nine miles an hour only on account of the density of the traffic.

The projected canal is designed to follow straight lines in the main. Where changes of direction occur, the outer channel lines of adjacent courses are to be carried to an intersection, which may be done with little additional excavation; the point of the inner angle will be dredged off so that a curve of 8,000 feet or more radius can be laid down wholly

within the channel limits. All the changes of direction in the stretch above described will be in a channel at least 600 feet broad above the turn and 300 feet below it.

Following the 200-foot channel through the deep portion of the Culebra Cut will come a stretch of close on two miles, with a width of 300 feet, to the locks at Pedro Miguel, where the summit level terminates. The duplicate locks at this point will have one lift of 31 feet.

LAKE SOSA.

On the farther side of the Pedro Miguel locks will be formed an artificial lake by the construction of three dams. This lake will have an area of about eight square miles and will extend from Pedro Miguel to Sosa Hill where duplicate flights of two locks each will be placed. The channel through Lake Sosa will be 500 feet wide for a distance of more than a mile and a half from the Pedro Miguel locks; it will then open out to 1,000 feet or more for the remainder of the distance.

The principal dam is the one at La Boca which extends from the locks at Sosa Hill across the mouth of the Rio Grande to San Juan Hill. The other dams extend from Sosa Hill to Ancon Hill and from Ancon Hill in the direction of Corozal to high land across the Panama Railroad. In order to provide

for the discharge of the Rio Grande and other rivers entering the lake during the construction of the earth dams, a diversion channel about 50 feet wide is to be cut through the slope of Sosa Hill, near the end of the Ancon-Sosa dam, and sluices or regulating works, similar to those designed for the Gatun dam, but of much less extent, are to be subsequently built in the channel.

EARLY SUGGESTIONS ADOPTED.

The idea of building dams at, or near, the ends of the canal and forming artificial lakes is not a new one; in fact it was amongst the very earliest suggestions made in connection with the canal enterprise. It was presented by Mr. Klietz to the International Congress of Engineers at Paris in 1879, but that body decided in favor of a sea-level waterway. The Gatun dam was suggested in a discussion of interoceanic canal projects by Mr. Ashbel Welch in 1880, before the American Society of Civil Engineers. Both the Gatun and Pacific dam projects were advanced in a paper read before that society by Mr. C. D. Ward in 1904, and were included by Mr. Lindon Bates in the plan submitted by him to the Consulting Board of Engineers.

The advantages of the terminal lake on the Pacific side are a saving of about $8,000,000 in the cost of the canal and greatly improved navigation secured

by the introduction of more than five miles of channel not less than 500 feet wide and 45 feet deep. It also dispenses with the sea-level cut from La Boca to Miraflores which involved several objectionable features.

From the Sosa lock to the seven-fathom curve in Panama Bay the distance is four miles. The channel along this stretch will be 300 feet wide and 45 feet deep below mean tide. These are the dimensions adopted by the Board for the sea-level project, and whilst accepting them, the minority take occasion to express their opinion that they might be increased in both respects with advantage to navigation. As, however, frequent dredging will be necessary to the maintenance of this channel, it is more than probable that it will become gradually enlarged.

Only about one-seventh of the entire channel, according to this project, having a length of 49.72 miles, is less than 300 feet in width, while more than two-thirds of it is 500 feet wide or over. The estimated cost of the canal to be built in accordance with this plan is "in round numbers," $140,000,000.

The estimated time required for the completion of the minority project is calculated upon much the same bases as those employed by the Board in making its time estimate, but the minority expresses the opinion that the allowance of their confreres for the completion of the Culebra Cut to 40 feet below sea level is much too low and that it should be not less

than fifteen years. Upon the assumption that it will require fifteen years to excavate the 110,000,000 cubic yards involved in the sea-level project, it is decided that the "time required for the lock canal with summit level at elevation 85, which requires the excavation of 53,800,000 cubic yards from the central mass, would be about seven and one-half years, a conclusion which is verified by a study of conditions in the heaviest portion; but before accepting this period as the time required to build the canal, consideration must be given to the question of time required to build the locks."

THE GATUN LOCKS.

Under the minority plan the greatest amount of lock construction will be needed at Gatun. The amount of excavation for this lock, embracing a distance of 3,136 linear feet, measured along the canal axis, will be 3,600,000 cubic yards, and the average width of the excavation will not differ greatly from the average width of the Culebra Cut in the heaviest section. Applying the standard of measurement that has been accepted for the latter operation, the Gatun excavation should be completed in four years. This is a conservative estimate, for, whilst the material at Gatun is at least as easy to excavate as that of Culebra, the general conditions at the former point are much more favorable to expedition.

The enormous amount of concrete masonry required for the Gatun locks — 1,300,000 cubic yards — is unparalleled in the building operations of modern times. If the plant and materials are deposited and arranged upon the ground whilst the preliminary work of excavation is in progress, rapidity of construction will be greatly facilitated. Judging from the experience in similar work on a much smaller scale and with fewer facilities, the report concludes that 8,000 cubic yards per day might be attained at Gatun. This calculation contemplates the simultaneous employment of 20 mixing plants distributed along the 9,000 linear feet of the main walls of the locks. The final estimate of time required for this work is, however, based, for the sake of conservatism, on a daily output of only 2,500 cubic yards. At this rate the entire concrete would be placed in two and a quarter years. The materials consumed in this daily output would amount to 4,000 tons. This quantity, large as it is, does not exceed one-fifteenth of the weight of the material to be daily removed from the Culebra Cut, and its transportation should not create any great difficulty. The only remaining work of magnitude connected with the installation of the locks is the erection of the gates, of which fourteen pairs will be required for the duplicate flights. Making a very conservative estimate, based upon the experience at the Poe lock in the St. Mary's Canal, where the climatic conditions and the facili-

ties were inferior, the report allows one year for this portion of the task.

The periods included in the preceding estimates aggregate about seven and one-half years, which is a shorter time than that calculated for the excavation of the Culebra Cut; but this lock calculation is made on the assumption that each of the three stages of the operation under consideration would be entered upon at the termination of that preceding, whereas they would in fact overlap and to a considerable extent be carried on simultaneously, thus effecting a considerable reduction in the total expenditure of time. The locks at Pedro Miguel and those at Sosa are of less magnitude than the structures at Gatun and would occupy a shorter time in erection. There is no other single work which will entail anything like the time needed for the cut through the divide.

Making ample allowance for possible delays, the minority members of the Board feel assured that the canal as projected by them may be completed in all its details within nine years from the time that operations are commenced.

DIFFERENCES OF OPINION AS TO TYPE OF CANAL.

There has been much diversity of opinion amongst experts on the subject of the type of canal. The preponderance of public sentiment is in favor of the so-called "sea-level" waterway, but it is generally based

upon a misconception. The idea that the sea-level canal recommended by the Board would be a wide channel that could be freely navigated by ocean vessels at comparatively high speed is altogether erroneous. There is unanimous agreement amongst engineers that the ideal waterway would be one of the dimensions of straits, which might receive the waters of the Chagres and be subjected to the full action of the Pacific tide without serious impediment to traffic. Such a waterway is, however, entirely infeasible. Its completion would occupy fifty or more years and its cost would not be less than $500,000,000. In the sea-level canal contemplated by the majority of the Board, one-half of the distance the bottom width of the channel is only 150 feet and for about the same distance it is 200 feet. These lateral dimensions with a depth of about 40 feet are considered the greatest economically permissible. The question at issue is the choice between such a canal and one at a high level with locks.

The weight of expert opinion is decidedly in favor of a lock canal. The Panama Canal Company was forced to abandon its sea-level project and the conclusions of the *Comité Technique* support the lock plan, but, since the French companies were influenced by restrictive conditions from which the American Government is free, we may leave their experience out of consideration. The first Walker Commission favored a lock canal, although its chief en-

gineer, Mr. Wallace, entertained a belief that the sea-level construction would be preferable. With one exception, the present Commission supports the recommendation of the five American members who made up the minority of the Consulting Board of Engineers. The President, Secretary Taft and Chief Engineer Stevens have lined themselves upon the same side and the weight of expert opinion, in this country at least, is, without doubt, similarly disposed.

THE BOARD DEPRECIATED THE "SOO" CANAL.

In reaching their decision, the majority of the Board failed to give to the experience of the Sault Ste. Marie Canal the degree of consideration which, in the opinion of American authorities, it should have excited. Nevertheless, the St. Mary Canal is, measured by traffic, the most important ship canal in the world. Although navigation through it is suspended during the winter months, the annual tonnage it accommodates is in excess of the combined tonnage of the Suez, Manchester, Kiel and Amsterdam canals and the Poe lock alone has three times the traffic of the Suez Canal during the season of navigation.

The difficulties and extent of construction would be much greater in the case of the sea-level canal than in that of the high level. Aside from the much greater excavation which would be for the most part in hard

rock, a large dam at Gamboa is provided for and tunnels and diversion channels to accommodate the superfluous waters of various streams. The plan of the lock canal is based on well-understood and tested conditions, whilst it is quite possible that unforeseen problems and difficulties might arise in the construction of a waterway at sea level. In other words, one form of canal involves less hazard than the other.

In the matter of permanency the project of the minority has a decided advantage. The high-level waterway may be deepened* and enlarged and its locks replaced by others of larger dimensions, at comparatively small cost and without serious obstruction to traffic, but increase in the size of the channel at sea level could only be effected at great cost, together with interruption to navigation.

In the comparison of capacity the difference between the forms of canal under consideration is particularly marked. Vessels of the largest size could not pass each other in the narrower waterway and there are two ships at present on the stocks whose load draft would bring their keels to within two feet of its bottom. It is doubted whether the largest type of ships could safely traverse the sea-level canal under their own steam and it is certain that they could

* Increased depth in Lakes Gatun and Sosa could be effected by the simple process of elevating the dams and spillways and admitting a larger volume of water, of which the supply is practically unlimited.

not exceed a speed of four miles an hour, whilst twice that rate would be quite practicable in the lakes forming the greater part of the lock canal. This advantage would more than compensate for the loss of time entailed in locking and would permit large vessels to make the transit by the high-level route in the shorter time. On the other hand, ships of smaller types would make the passage through the canal at sea level with about half an hour's saving in time.

The majority of the Board seem to have entertained fears of the safety of the locks which the American authorities, whose experience in this respect is unequalled, consider unwarranted. The latter express the utmost confidence in the locks and declare that the danger of blocking is much greater in the case of the narrow waterway than in that of the other. It is admitted by the advocates of the lock project that the mechanical structures in a canal of that type would be easily damaged or destroyed by an enemy, but they deem the commercial advantages paramount to military considerations.

In regard to time and cost of construction, the high-level canal has altogether the better of the argument, and especially so since the Commission seems to have demonstrated that the sea-level canal cannot be completed at a smaller outlay than $272,000,000 and in less time than eighteen or twenty years.

In passing the Spooner Act, Congress had in mind a canal such as was planned by the Walker Commis-

sion: that recommended by the Administration and the present Commission conforms to the former in the essential features and departs from it only in the direction of improvements. No further Congressional action is necessary in order to proceed on these lines, but new legislation, including an increased appropriation, would be needed for the prosecution of the sea-level project.

NOTE.— Almost at the moment of going to press, it is learned that the Senate Committee on Interoceanic Canals has, by a majority of one, decided to report in favor of the so-called "sea-level" canal. This decision is believed to be attributable to nervous apprehension, excited by the recent San Francisco disaster. Inadequate as is that reason, it appears to be the only one assignable to the surprising course of the Committee. That the weight of expert opinion is preponderatingly in favor of the lock, or high-level plan, is indisputable. Prudence, public policy, and the interests of the tax-payer point in the same direction. There are hazards involved in both projects, but by far the greater proportion attach to the sea-level undertaking. As to the earthquake risk, a shock that would seriously injure the lock canal as planned might be expected to work equal, or greater injury to the sea-level channel, and such a shock is not within the recorded experience of the Panama region. The sea-level plan includes dams, levees, and locks, connected with a waterway so restricted in dimensions, that any disturbance of its normal conditions could not fail to subject traffic to grave inconvenience and danger. In this connection it should be noted that the earth dams at San Francisco and Oakland, which are much less strong and massive than that proposed for Gatun, appear to have survived the recent convulsion on the Pacific Coast without damage.

X.

PANAMA.

VARIOUS ASPECTS OF THE CANAL.

The Health Problem — The Opinions of a Medical Expert — The Sanitary Campaign — Conservative Views of Colonel Gorgas — The Labor Question — Many Lands Will be Drawn Upon for Labor — Poor Quality of Labor is one of the Chief Drawbacks — Expensive Character of Low-grade Labor — The Canal and the Commerce of America — Effect of the Canal on the Commerce of the South — Great Benefits to Our Pacific States — A Boon to the Northeastern Territory — Our Advantage Over Foreign Competitors — Political and Military Aspects — Difficulty of Guarding the Canal.

No material work of man since the creation of the world has had so deep and widespread influence upon the affairs of mankind in general as that which may calculably be expected to ensue from the establishment of the Panama Canal. The results will be seen in commercial, political, social, and even religious, effects. It will make and mar the fortunes of nations. Cousin, the French philosopher, has said: "Tell me the geography of a country and I will tell you its destiny." By creating important modifications in the geographical relations of certain communities the Canal will be the me

about great and lasting changes which are beyond the range of accurate forethought. The subject is a vastly interesting one that would afford ready material for a volume of speculative studies, but our present purpose will only permit a limited consideration of a few of the most obvious conditions connected with the construction and future operation of the prodigious waterway.

THE HEALTH PROBLEM.

The question of sanitation, closely allied as it is to that of labor, has always been an important factor in operations conducted upon the Isthmus of Panama, but fortunately, with the advance of time, the difficulties presented by it have become ever more susceptible to scientific treatment. The Panama Railroad was built at an appalling sacrifice of life. At that time a blind contest was waged with disease, but no serious effort was made to mitigate the conditions that produced it. The French companies adopted some preventive measures and their provision for the care of the sick was admirable, but it remained for American administration to attack the problem in the determined and radical manner that promises to minimize effects by reducing causes.

The observation and experience of medical scientists in recent years has led to the conclusion that the dangers to health and the difficulties of sanita-

tion in Panama have been very much exaggerated. It is believed that the climate is not nearly so harmful, even to white men, as has generally been supposed. Due allowance has not been made hitherto for the indulgent habits of most of the French employees of the canal company, nor for the poor physique of a large majority of the laborers engaged by it. Furthermore the physical conditions of the scene of operations have undergone great changes since the inception of the work and we are now past the stage of surface disturbance, when deadly emanations were constantly released by the excavations. Several active factors of a favorable character enter into the present calculations of the sanitary department. The cities of Panama and Colon are being rapidly placed in possession of good and adequate water and sewerage systems and strict quarantine regulations are enforced. Certain unsanitary practices of the inhabitants of the Canal Zone and the cities in question have been abated and will be abolished. Add to all this the war on the infectious mosquito and we have conditions that ensure a vast improvement in the general health of the Isthmus. Still it is not expected that the utmost results hoped for will enable white men in general to perform manual labor at Panama any more than they may in other tropical regions. The object sought, and which will surely be attained, is to eliminate all unnecessary inimical conditions and limit the difficulty of re

Isthmus to mere resistance to a tropical climate of not extraordinary severity.

THE OPINIONS OF A MEDICAL EXPERT.

In this connection we can not do better than quote Doctor Lacroisade, who resided on the Isthmus in an official medical capacity from 1887 until recently: "Among the diseases attributed to the climate the most numerous are simple marsh fevers, which have not occasioned a single death. Two diseases only belonging to the epidemic type have appeared — the beriberi, of which there is no longer any question,* and yellow fever. The latter, after having been absent from the Isthmus for at least six years, was imported in 1897, and continued about six months, from March to August, when it again disappeared after very slight ravages (only six deaths). Thus it can not be considered that this pest is really epidemic on the Isthmus. From the other infectious epidemics, such as variola, typhoid fever, diphtheria, etc., the Isthmus appears to be almost entirely exempt. From the foregoing we may conclude that life on the Isthmus scarcely incurs more dangers than

* The disease, which had probably never before been known in the region, was introduced with an experimental importation of negroes from Africa, and disappeared when they were returned to their homes, but it has recurred. There were no fewer than thirty-two cases in the Ancon Hospital during October, 1905.

elsewhere, even for Europeans, who, after the blacks of the British Antilles, appear to resist the climate best. Residence here would, then, offer nothing alarming, were it not for a constant feeling of fatigue and uneasiness due to a temperature always high, and an atmosphere saturated with moisture." In thus advancing arguments against the exaggerated notions prevalent regarding the climate and sanitation of the Isthmus there is no thought of detracting from the splendid work which the medical officers are performing under the Commission. The object is to show that with their aid the canal operations may be, and doubtless will be, completed without an attendant heavy mortality. The Walker Commission was accompanied on its first visit to the Isthmus in March, 1904, by three eminent physicians, who had achieved wide distinction by their sanitary work in Cuba. They were Colonel Gorgas and Major La Garde of the United States Army and Captain Ross of the Navy. The sanitary work of the Isthmus was entrusted to these officers, but they occupied distinctly subordinate positions and had no voice in the Commission nor, it is believed, the degree of independent authority in their particular sphere of labor with which they should have been invested. Amongst the charges of inefficiency that were brought against the former Commission was that of failure to give sufficient consideration to the immediate demands of sanitation. It was generally understood that the

medical staff felt dissatisfied with conditions on the Isthmus in so far as they related to the departments of health, but it is much to the credit of those officers that they made no public complaint and pursued their efforts with unimpaired zeal whilst conscious that the arrangements were far from the best possible. Perhaps the Walker Commission may be excused for devoting its immediate and closest attention to excavation when we remember the unreasonable impatience of the press and the people to see "the dirt fly." One of the members of the former Commission has declared that it was fully appreciative of the wisdom of the policy since adopted and at present in force, and the presumption is that in following a different course Admiral Walker and his associates were impelled by a desire to have "something to show" as soon as possible.

One of the first important decisions of the Executive Committee of the Shonts Commission was to stop the work of excavation and to direct the labors of the entire force upon sanitary improvements. This policy is based upon a conviction that after the region has been cleansed and subjected to preventive measures and when proper provision has been made for lodging and feeding the laborers and employees the construction will progress with greater speed and fewer casualties than if it were to be pushed ahead without such preliminary work.

Aside from the permanent improvements at the

terminal ports the most important element in the task of sanitation is that of destroying or rendering innocuous the mosquitoes, through whose agency malaria and yellow fever are propagated. A similar problem was presented to Colonel Gorgas and his associates in Havana. The methods followed there, with necessary modifications, will be adopted in Panama.

THE SANITARY CAMPAIGN.

The plan is simple but entails a vast amount of labor. It is thoroughly established that the anopheles becomes infected by biting a sufferer from malaria. The first step, then, is to bring under immediate supervision, as nearly as possible, all the malarial subjects within the Zone, and to carefully isolate them within screens until the malarial parasite has been eliminated from their blood. Meanwhile a vigorous campaign is in progress against the insect carrier. Long grass and rank vegetation is cut down all along the line, pools are swept out and sprinkled with oil, dwellings are cleansed, and, in short, every effort is made to destroy the pest. Referring to the result experienced from similar action in Havana, Colonel Gorgas says: "At the end of about eight months of this work it was found that the number of yellow-fever mosquitoes had been greatly decreased, and those that were left could find no human being infected with yellow fever, whereby

they, the yellow-fever mosquitoes, might become infected, and thus convey it to other human beings. For the past three years Havana has been free from yellow fever. An unacclimated man can go to Havana now, and though he may probably be bitten a good many times by yellow-fever mosquitoes these mosquitoes have had no opportunity in the past three years of biting a human being infected with yellow fever, and therefore are themselves entirely harmless. This condition we hope to bring about in the villages along the canal route by means similar to those adopted in Havana."

CONSERVATIVE VIEWS OF COLONEL GORGAS.

We will close this discussion of the health problem with a further quotation from Colonel Gorgas, in which it will be seen that his ideas conform very closely to those expressed by Doctor Lacroisade: "The Panama strip is now about as healthy as the ordinary tropical country. The death rate is a great deal higher than that in New York, but this would be the cast almost anywhere in the tropics. About twenty people per thousand in New York die every year and about fifty per thousand at Panama. The general idea about Panama seems to be that we shall suffer as the French did and as all former European venturers into Panama did, and that instead of dying as we do in New York at the rate of twenty per

One of the Commission's Ho

thousand per year, we shall die, as sometimes occurred to the French and others at Panama, at the rate of five or six hundred per thousand a year. Other men of experience in the tropics and who have been at Panama for some time, maintain that the matter of sanitation is exceedingly simple and easy, and that the health of the Panama strip ought to be as good as that of most parts of the United States. Both opinions, it seems to me, are extreme, and the truth will fall somewhere between the two. Any health officer with experience in dealing with a practical question of this kind will know how exceedingly difficult it will be in a population of about fifteen thousand † people infected with malaria to devise and apply any system by which the cases can be individually recorded and treated. Personally I approach the problem with hope and the expectation of having approximately the same success that rewarded similar efforts applied by our military authorities in Cuba. But it is no simple matter. We shall no doubt meet with many disappointments and discouragements, and shall succeed in the end only after many modifications of our plans and after many local failures." *

† This refers to the population of the villages along the line of the canal.

* It may be added that this was written about twelve months ago and that at the present time a great degree of success is within sight.

One of the Commission's Hotels for Employees.

Each of the enterprises that preceded the American occupation of the canal territory found the difficulty in securing satisfactory labor one of the greatest deterrents to success.

THE LABOR QUESTION.

The experiences of the railroad and French companies embraced the enployment of almost every available form of labor and seemed to point to the conclusion that, all things considered, the West Indian negro is the best adapted to the work. The French did the greater and most satisfactory portion of their work with Jamaican field hands and the majority of laborers at present upon the pay-rolls of the Commission are of the same class, but it is questionable whether the enlarged demand which will presently exist can be satisfied from the same source. Secretary Taft has already expressed his misgivings on this score. In the early part of the year 1905 he reported to the President the result of a visit to Jamaica undertaken for the purpose of sounding the local authorities on the subject. "The governor of Jamaica," the Secretary states, "was unwilling to consent to our taking 10,000 laborers from the islands unless we deposited five pounds sterling per laborer with the island government to meet the burden which his leaving the island would probably throw upon his parish under the poor law of the

island for the support of those dependent upon him. He also insisted that we should agree to pay the expenses of the return of each laborer whether he was satisfactory or not and whether he abandoned the work in violation of his contract or not." Such terms are of course completely beyond the question of acceptance, but there is a strong probability that a large number of laborers will go to the Isthmus from Jamaica of their own initiative. There are two regular lines between Kingston and Colon which carry passengers from one port to the other for five dollars a head. Of course there is a great inducement in the fact that the wages offered on the Isthmus are twice as much as those paid in Jamaica.

MANY LANDS WILL BE DRAWN UPON FOR LABOR.

The Jamaican negroes like the service and the extremely good treatment they receive. A very large proportion of those who enter the employ of the Commission remain in it. There is, however, a tendency among them to take a holiday whenever their accumulated savings will permit, and so there is a constant flow of laborers to and fro between Jamaica and the Isthmus. The Commission has hope that natives of the north of Spain will prove more satisfactory than any laborers heretofore employed and it is believed that they can be secured in large numbers. The governor of Porto Rico has expressed his opinion

that the agricultural laborers of the island may be satisfactorily employed on the canal works, and it is the intention of the Commission to try a selected number. At the same time a test will be made of one thousand Chinamen and the same number of Japanese contract laborers. Not a great deal should be expected from the Porto Ricans probably, but if exemption of the Canal Zone from the operation of the Chinese exclusion law is effected a large proportion of the permanent working force will in all likelihood be drawn from China. There is no good ground for hope that Japan will furnish any considerable number of the laborers required. The Japanese are not capable of great exertion in a tropical temperature. The climate of Formosa, which is not nearly so trying as that of Panama, overtaxes their powers of endurance. Furthermore, several years must elapse before Japan can spare any considerable number of laborers from her own neglected fields. Aside from the mere matter of digging, Chinese are likely to be very desirable employees in the future. The construction of a multi-lock canal will involve a great deal of cement and other work closely approaching to expert labor, and requiring for its proper accomplishment a degree of intelligence on the part of the workman, which, in the absence of white labor, may only be looked for in the Chinaman.

The real difficulty of the labor situation pertains less to quantity than it does to quality. Prob[illegible] the

Commission will eventually be able to secure as many men as it desires from one source and another, but unless the standard of efficiency which has hitherto obtained in the "silver" force of the operation is enhanced the labor problem will continue to be a serious one.

THE POOR QUALITY OF LABOR IS ONE OF THE CHIEF DRAWBACKS.

It is the general agreement of those who are in position to judge from experience, that the efficiency of the common laborer on the canal is not in excess of 33 per cent measured by the American standard. In this connection Mr. Stevens says: "On the basis of the present rates of pay for West Indian colored labor, which is the lowest grade of labor, we are paying 20 cents silver per hour, and on the 8-hour basis, to which we are confined by law,* it is $1.60 silver per day, or 80 cents gold. The relative efficiency of this labor as compared to ours at home is about three to one. In other words, we are paying to-day for this labor $2.40 in gold, or $4.80 in silver. Close inspection of the different gangs, which extended over at least five months, demonstrates very clearly that the average superintendent or foreman, either white from the Northern States, or colored from Jamaica

* This hampering restriction was recently removed by Congress.

and the other West Indian islands, has never been able to work continuously more than 50 per cent numerically of the different gangs. . . . Instead of obtaining a fairly continuous amount of labor, as we do from gangs here at home, one-half of the efficiency of this colored labor is lost, owing to their deliberate, unceasing, and continuous effort to do as little work as possible. In other words, instead of our colored labor costing us $2.40 per day, the real situation is that we are paying twice $2.40 gold per day, or almost $5 for eight hours labor."

EXPENSIVE CHARACTER OF LOW-GRADE LABOR.

Nor is the item of wages by any means a full measure of the excessive expense entailed upon us by the necessity of employing low-grade labor. Not only are we paying for this 300 per cent of its true value judged by our standard, but the employment of it entails upon us in incidental expenses, connected with housing, feeding, hospital treatment, supervision, etc., probably three times as much as would be expended upon one-third the number of men.

To put the statement in another form: White labor, if it were practicable, would do the work upon the canal at a wage of $2.50, gold, per day. We pay for colored labor of 30 per cent efficiency, 80 cents per day, which would make the rate practically the same but for the fact that the colored laborer

works on an average only half the time for which he draws pay. Hence our colored labor costs in wages twice as much as would white labor. But since it is necessary to employ three times as many of the former as of the latter to perform a certain amount of work, our incidental expenses, which may be reckoned on a per capita basis, are probably three times as great in one case as they would be in the other.

The West Indian laborer entertains the idea, not without good reason, that he is indispensable to the progress of the operation and the only prospect of getting good work from him depends upon creating competition by the introduction of Chinamen or some equally efficient laborers.

THE CANAL AND THE COMMERCE OF AMERICA.

The establishment of a waterway between the two great oceans of the globe will more widely affect the commerce of the world than any single work or event in its history. President Hayes, in 1879, declared that "an interoceanic canal across the American Isthmus will essentially change the geographic relations between the Atlantic and Pacific coasts of the United States and between the United States and the rest of the world." The Panama route will effect mu[illegible] greater economies of time and distance than tho[illegible] are at present secured by the use of the Sue[illegible]

Colquhoun, in his "Key to the Paci[illegible]

"It will bind together the remote sections of that immense country, assimilate its diverse interests, go far towards solving many difficult problems, and make the United States still more united. . . . No greater impulse to commerce can be given than this complement to the Suez Canal. It will benefit America in an infinitely greater degree than Europe. . . . It will give an immense impetus to United States manufactures, especially cotton and iron, and will greatly stimulate the shipbuilding industry and the naval power of the United States."

Whilst the opening of the Panama Canal must prove an universal boon it will doubtless work to the detriment of some countries and certain industries, at least until after adjustment of the new trade relations. America will always be the greatest beneficiary of the advantages accruing from the use of the waterway and we will briefly consider a few of the conditions that may most surely be calculated upon to follow the completion of the enterprise to which so large an amount of American energy, intellect and capital is devoted.

EFFECT OF THE CANAL ON THE COMMERCE OF THE SOUTH.

No region in the United States may be expected to feel the immediate benefit of the new route to the same extent as the Southern States and the vast Val-

ley of the Mississippi. The latter territory, the richest in all the world, one and a quarter million square miles in extent, intersected by five thousand miles of navigable waterway, with prolific soil and energetic people, will find new markets and a new outlet for its varied products no longer dependent upon expensive railway transportation. Chicago is nearly the same distance from New Orleans as from New York, but St. Paul, Omaha, Dubuque, Evansville and Denver are nearer to the former point than to the latter. It is quite probable that the present generation will see ocean steamships coming down from Duluth, through the Great Lakes, an inland canal, and the Mississippi River, to the Gulf of Mexico, and passing on to Pacific and Asian ports.

The opening of the new gateway to the Pacific will give a tremendous impetus to the industries of the South. Its raw cotton, which for a decade has been making small gains, under difficult competition with the British East Indies and China, in the Japanese market, will be relieved of an onerous handicap. The product of its mills, a coarse fabric, such as is especially adapted to the requirements of South American and Oriental consumers, must enjoy an enlarged demand under stimulating conditions. At present almost all the cotton goods exported from this country to Asia go out through New York eastward by way of the Suez Canal.

Alabama coal will find a constant and extensive

demand at Panama, which will become the greatest coaling port in the world. Birmingham, where iron can be produced more cheaply than at any other place on the earth, will find new markets in South America and Asian countries for its output. The steel, machinery, and various hardware of Tennessee and other Southern States, which have been reaching Australia and China during the past few years under the most disadvantageous conditions of shipment, will be sent through the Canal to these and other destinations at a cost which may defy competition. The large lumber and wood manufacturing industries of the South will be obviously benefited to a great extent by the creation of a short route to the western coasts of Central and South America.

GREAT BENEFITS TO OUR PACIFIC STATES.

The immense saving in the journey from our eastern ports to the Pacific Coast will revolutionize the trade of the latter region. Von Schierbrand says: * "It has been computed that on a single voyage of a 1,500-ton sailing vessel between Port Townsend, Seattle or San Francisco and Boston, New York or Philadelphia, the saving effected in wages, repairs, insurance, provisions, and freight charges, by reason of the Panama Canal will aggregate between $8,000 and

* America, Asia and the Pacific. Wolf von Schierbrand. New York, 1904.

$9,500." Many raw products of our Pacific Coast, which at present can not bear the cost of long railroad hauls, will be made available to eastern markets at prices profitable to the producer and the manufacturer. This applies particularly to building lumber and furnishes a partial solution to the problem with which the rapidly disappearing forests of our middle and eastern states are confronting us. The economies that will be effected in the transportation of the cereal and fruit products of California and other western regions may easily be imagined. Millions of pounds of fish are sent annually in ice across the continent, aside from the enormous quantities that go to Europe in English sailing vessels round Cape Horn. All this would pass through the Canal if it were open, and the present shipments of salmon alone would require twenty vessels of 2,000 tons each.

The Canal will be the means of enabling the people of the Pacific Coast to buy more cheaply and to secure better prices for their products. By breaking the monopolistic power of the railroads it will lead to the agricultural development of the unoccupied sections of this territory, to a vast increase in its population and to the creation of world-wide markets for its products.

A BOON TO THE NORTHEASTERN TERRITORY.

The industries of the northeastern section of the

United States, that is to say the territory lying to the east of Pittsburg and to the north of the James River, consist mainly of the manufactures of iron and steel, machinery, tools, etc., and textiles, coal mining, and shipbuilding. The exports of manufactured cotton from this and other parts of the United States go principally to ports in Asia and Oceania, where their chief competitor is the product of the British mills. It is not necessary to expatiate upon the advantage which the short route will give to us in this trade. The countries of South America expend about $80,000,000 annually in the purchase of cotton goods. At present, however, little more than five per cent of this large sum is paid for American cloth, but the facilities for shipping economically that will be created by the Canal must have, among other results, that of giving to the manufacturers of our Northeastern and Southern States a very large share of this desirable business.

It is hoped that by the use of a new type of steel river barge of large capacity and small draft the coal of Pennsylvania and the Southern mines may be shipped direct to Panama at a cost of one dollar per short ton. This would allow of its being sold at three dollars, a figure sufficiently low to preclude successful competition. The ability to supply cheap fuel would not only accrue to the benefit of our coal mining interests, but would, where other considerations balanced, decide shipmasters in favor of

the Panama route, for the contract price of steam coal at Port Said is about six dollars and the current price about ten dollars per ton.

OUR ADVANTAGE OVER FOREIGN COMPETITORS.

The principal exporting competitors of the United States in the markets for the manufactures of iron and steel are Great Britain, Germany and Belgium. European producers can reach the west coast of South America, and the oriental countries in general, more readily than can our manufacturers, but the opening of the Canal will entirely subvert the condition in the favor of the latter. Few of our industries are likely to receive such an expansive impulse from that event as those dependent upon iron and steel for their material and the section which will benefit most in that respect is the coal and ore region of the South.

One of the most certain consequences of the increased American trade that will follow the establishment of a waterway between the Atlantic and Pacific Oceans will be the great extension of the merchant marine and the expansion of the shipbuilding industry of the country. The Canal will have the effect of largely increasing the coasting trade of the United States and all the vessels engaged in it must be built in American yards. Aside from this the increased foreign trade under conditions that will make the shipping business once more profitable, must lead

to the construction of a large additional number of American vessels.

A large shipbuilder responded to an inquiry by the Isthmian Canal Commission with the following statement: "In my judgment the opening of the isthmian canal and the development of its traffic would stimulate American shipbuilding to the extent of an increased demand for vessels to be used in trade affected by said canal. As a rule increased demand develops increased sources of supply and the cost of product is invariably reduced in proportion of increased business to fixed expenses of any manufacturing establishment, and therefore the canal would in this case tend to enable shipbuilders to construct ships more economically and more surely to compete with foreign builders."

The foregoing are only a few illustrative examples of the benefits to certain portions of the United States that may be counted upon from the construction of the Panama Canal. Anything approaching a comprehensive statement of the matter would fill a large volume.*

POLITICAL AND MILITARY ASPECTS.

Although the prime purpose of the canal is essen-

* The subject has been extensively treated by Professor Emory R. Johnson in the report of the Isthmian Canal Commission of 1899–1901.

tially of a commercial character, its construction can not fail to entail important political results. These will be felt chiefly by the countries of the American continents and the adjacent islands. The Spanish-American republics, by being brought into closer and more frequent relations with the older civilizations will learn the lessons of modern government and the advantages of ordered and industrious social conditions. Whilst affording greater facilities for military movements, the Canal will ultimately prove to be a potent factor in the abolition of war. Without venturing too far into the realm of fancy, it may be permissible to suggest one, by no means improbable, means to this end. Perhaps no agency within the bounds of present possibility could so effectively maintain the peace of nations as an alliance for that purpose and for mutual defence between the great naval powers, Britain, America and Japan. The bonds of friendship and commercial interest are more closely drawn in the case of these three peoples than between any other nations in the world and they will be the chief beneficiaries of the commercial and military facilities derivable from the Canal.

THE CANAL PART OF OUR COAST LINE.

To the United States the isthmian passage between the oceans has become a military necessity. The need for a short route from one coast to the other of

our country was forcibly felt when the Pacific territories were acquired and again when at the outbreak of the war with Spain, the battleship Oregon was obliged to make the long journey round Cape Horn in order to join the Atlantic fleet. The Canal will become, as President Hayes tersely put it, "a part of the coast-line of the United States." It will be essential to the safety of this country that the Canal is preserved from the possibility of falling into the hands of an enemy in time of war. It will be a simple task to fortify the entrances, but to guard the whole extent of a structure so susceptible to damage would be an altogether different matter and it would not perhaps be feasible and certainly not desirable to employ guns and forts for that purpose.

DIFFICULTY OF GUARDING THE CANAL.

A canal of any type must necessarily be extremely vulnerable. A few sticks of dynamite in the hands of determined men would put it out of use for a greater or less period. Nor could any practicable system of precautions insure immunity from such a hazard. Fortifications would be futile, for a covert attack by a small body would be more likely to succeed than an assault in force. Aside from guarding locks, dams and other important works it is difficult to conceive of anything like effective defensive measures. In this connection the Isthmian Canal Com-

mission of 1899–1901 said: "It is the opinion of the Commission that a neutral canal, operated and controlled by American citizens, would materially add to the military strength of the United States; that a canal, whether neutral or not, controlled by foreigners, would be a source of weakness to the United States, rather than of strength; and that a canal not neutral, to be defended by the United States, whether by fortifications on land, or by the navy at sea, would be a source of weakness."

The question is amongst the many problems connected with the Canal which are receiving the careful consideration of the Government, and it is quite probable that it will decide that we must depend upon the Navy to prevent any hostile force from landing upon the American Isthmus.

Our possession of the Canal has emphasized the desirability of the United States owning the West Indies, or at least the four islands constituting the Greater Antilles, which most effectually control the approach to the Caribbean Sea, and are characterized by Captain Mahan as "the very domain of sea power, if ever region could be called so."

Distances from American and European Atlantic Ports, to Pacific Ports, via the Panama Canal.

FROM—	To Port Townsend, via San Francisco.	To San Francisco.	To Guayaquil.	To Callao.	To Iquique.	To Valparaiso.	To Coronel.	To Yokohama, via San Francisco. *a*	To Shanghai, via San Francisco and Yokohama. *a*	To Manila, via San Francisco and Yokohama. *a*	To Sydney, via Tahiti, *b*	To Melbourne, via Tahiti, *c* and Sydney. *b*	To Wellington via Tahiti. *d*
New York	6,074	5,299	2,864	3,359	4,021	4,630	4,838	9,835	10,885	11,585	9,852	10,427	8,892
Norfolk	5,872	5,097	2,662	3,157	3,819	4,428	4,636	9,634	10,684	11,384	9,650	9,858	8,690
Charleston	5,673	4,898	2,463	2,958	3,638	4,229	4,437	9,344	10,367	10,809	9,451	10,006	8,491
Port Tampa	5,328	4,553	2,098	2,593	3,255	3,864	4,072	9,069	10,119	10,819	9,086	9,661	8,126
New Orleans	5,477	4,698	2,263	2,758	3,420	4,029	4,237	9,234	10,284	10,984	9,251	9,826	8,291
Galveston	5,574	4,799	2,364	2,858	3,520	4,129	4,338	9,335	10,385	11,085	9,352	9,927	8,392
Liverpool	8,813	8,038	5,603	6,098	6,760	7,369	7,577	12,574	13,624	14,324	12,591	13,166	11,631
Hamburg	9,242	8,467	6,032	6,527	7,189	7,798	8,006	13,003	14,053	14,753	13,020	13 595	12,060
Antwerp	8,963	8,188	5,753	6,248	6,910	7,519	7,727	12,724	13,774	14,474	12,741	13,316	11,781
Bordeaux	8,713	7,938	5,503	5,998	6,660	7,269	7,477	12,474	13,524	14,224	12,491	13,066	11,471
Gibraltar	8,447	7,672	5,237	5,723	6,394	7,003	7,211	12,208	13,258	13,958	12,225	11,188	11,265

a Via Honolulu adds 252 miles. *b* Omitting Tahiti reduces voyage from Brito by 52 miles.
c Voyage from Brito to Sydney by Wellington is 232 miles less than by way of Tahiti; from Panama it is 405 miles less.
d Voyage from Brito to Wellington direct is 185 miles shorter than via Tahiti, and from Panama it is 358 miles shorter.

XI.

PANAMA.

PREPARATORY WORK ON THE ISTHMUS.

Difficulty of Gauging Work Done — The Work of the French Companies — Deteriorated Property — We Have Greater Opportunities Than Had the French — The Death Roll Under French Management — Former Condition of Panama and Colon — Sanitary Detective Work — Extensive Work of the Sanitary Department — the Question of Food Supply — Extraordinary Treatment of the Laborers — Improvements in the City of Panama — Conditions in the City of Colon — The Opinions of an Expert — Mr. Hunter is Favorably Impressed with Conditions — The Panamans Are Satisfied with the Situation — Heavy Expenditures for Material and Supplies — A Clean and Well-directed Management.

Considered in all its aspects, the Panama Canal is undoubtedly the greatest material enterprise of modern times. Nevertheless, no question in recent years has been generally discussed with so little discrimination and so much ignorance of the facts. The average citizen depends upon his newspaper for information in such cases as this, and the American press, with few exceptions, has treated this great national undertaking in a manner which must be characterized either as inefficient or unfair. There

has been displayed, almost from its inception, a pessimistic attitude towards the project and a hypercritical attitude towards its management that are not consistent with an understanding of the task and a knowledge of the conditions attaching to it. There has been an incomprehensible readiness to print any silly canard in connection with the undertaking, and no story, apparently, has been too extravagant to meet with wide credence. One or two of the most flagrant instances of misrepresentation have, it is true, been characterized by a degree of mendacity sufficiently transparent to defeat its purpose, but on the whole, unjustifiable criticism by publications of large circulation has seriously hampered the work of the Commission and perhaps, somewhat impaired the efficiency of the personnel under its direction. The bilious effusions of yellow journalism and the mendacious maunderings of sensation-mongers never furthered a good cause and can neither be expected to help us build the canal nor to aid us in arriving at a better understanding of the unfamiliar matters relating to it.

The Panama Canal is the greatest engineering undertaking in the history of the world, and its accomplishment involves deeper problems and more difficult tasks than those with which any similar enterprise in the past has been beset. The best talent and the most active brains of all civilized countries have contributed to the perfection of the plans, and

we have every reason to believe that the consummation of them has been placed in the hands of the best men available in America. It is safe to say that no great engineering work ever entered upon the constructive stage under more favorable conditions and with better prospects for success. Excellent work has been done during the period of preparation. We have an assurance of this fact in the unequivocal statements of officials who are in the best position to judge. They include our President and are all men whose word is unimpeachable. But, if that were not sufficient, the testimony might be adduced of every disinterested individual whose professional training, and experience on the Isthmus have been such as to render his judgment weighty.

DIFFICULTY OF GAUGING WORK DONE.

It is difficult to conceive of an undertaking in which so much effective work might be done with so little to "show for it" as in this. Much, indeed, of the most important labor has no visible result at present. The extensive surveys, the borings, the fluvial investigations and a hundred similar researches are in evidence only in the office files. Even the splendid sanitary achievements are to be realized only by an examination of the records, which bear eloquent testimony to the scientific attainment and determined energy of Americans. Nor is it possible

for one to appreciate the vast amount of work that has been done in the matters of organization and equipment unless he has some technical knowledge of such affairs and an opportunity for comparison with the pre-existing conditions. The progress that has been made on the Isthmus can not be discerned by casual inspection. The observer who permits superficial phenomena to fill his eye to the exclusion of sub-surface indications can not avoid erroneous conclusions and unwarranted judgments. Photographing discarded French machinery and nosing about in gutters and backyards are not conducive to a broad view or a just appreciation of what has been accomplished by our people on the Isthmus. The bruised and bandaged victim of a railroad collision affords little scope, except to the practised surgeon, for accurate judgment as to his condition when admitted to the emergency ward, or as to the treatment which he has received. What would we say of the visitor to a hospital who should allow the pervading presence of sickness and disease to excite his condemnation of the faculty, in ignorance or disregard of the fact that they are not responsible for its existence and have accomplished much towards its alleviation and cure. And, as the conduct of the most efficient hospital will not be free from failures and mistakes, so these will be experienced, and should be expected, in the course of so extensive an operation as the construction of the Panama Canal.

A clearer understanding of the present state of affairs in the Canal Zone and of the progress that has been made since American occupation will be secured by a review of the conditions and work during the French tenure.

Little excavation has been done on the line of the canal since 1889, when the Old Panama Canal Company failed. During the five years of receivership nothing more than the preservation of the property was attempted. In 1894, the New Panama Canal Company resumed the excavation of the divide in a restricted manner. At no time had they as many as 4,000 laborers employed, and when the United States came into possession, in 1904, the number was about 600. Aside from the limited excavation mentioned, the new company performed no work in furtherance of the project than some dredging at La Boca.

THE WORK OF THE FRENCH COMPANIES.

The French companies made extensive surveys and soundings and the results of these investigations were amongst the most valuable of the assets turned over to us. The Old Panama Canal Company erected many buildings, shops, hospitals, etc., but along the line of the canal its operations were confined to excavation, except for the construction of some inadequate docks and piers at Colon. Along the low

marshy stretch between that point and Bohio the company dredged a channel with an original bottom width of 72 feet and a depth, near Mindi, of 29 feet below sea level, gradually decreasing toward its end. The portion of this channel between Mindi and Gatun, 11 miles in length, comes within the alignment of the prospective canal. The cut between Colon and Bohio and the excavation at Culebra are the two largest and most impressive features of the operation in its present condition. Omitting the divide, there is a shallow but almost continuous ditch between Bohio and Miraflores, which will not serve to expedite the American project. A large amount of material was removed by the old company at the continental divide and a moderate amount — about 7,000,000 cubic yards — by its successor. The original height of the summit at this point, 333 feet above sea-level, has been reduced to about 170 at the maximum depth. The old company excavated the canal for a distance of about two miles from La Boca to an average depth of about 20 feet from the original surface, which is at nearly extreme high water. As the extreme range of tide at the Pacific terminus of the canal is about 10 feet above mean sea level to 10 feet below, the old company planned to make the Pacific sea-level section of the canal, from Miraflores to deep water, 39.4 feet deep below mean tide. Less than one-third of the total requisite excavation was made between La Boca and Miraflores, nor was a

channel to full depth completed from La Boca to the deep water of Panama Bay. The old company excavated a number of diversion channels aggregating about 40 miles in length. Very little of this work can be utilized in the execution of the plans of a lock canal.

A total amount of about 80,000,000 cubic yards of all classes of material has been excavated throughout the entire length of the canal. By far the greater part of this was soft material or earth removed with dredges, and most of the future cutting must be through rock, much of it hard enough to necessitate blasting. Of course the entire cutting at the divide is of a useful character, but it is probable that all told, less than half the excavating done by the French will be available in future construction.

DETERIORATED PROPERTY.

Immense quantities of material, machinery, and appliances were received by the old company and distributed along the entire line of the canal, and are still upon the Isthmus. The book value of this property is about $29,000,000. Much of it is under cover and in good order, but practically useless, because obsolete; the greater portion of it is scattered along the line of the canal, exposed to the elements and in various states of disrepair and decay.

Upwards of 2,000 buildings, mostly houses for

employees, were transferred to us by the French company. In general these were capable of being put into service, but most of them needed restoration or alteration. The buildings included, besides excellent hospitals, six machine shops of large capacity with a fair equipment. These have been enlarged and better furnished and will prove of great service in repairing machinery, rolling stock, etc., and may be utilized in building some of the minor plants required in the work.

When the United States took possession of the canal strip, two years ago, the conditions were chaotic. The Canal Zone had reverted to a state of wilderness. Machinery, rolling stock, and appliances were scattered throughout its length and overgrown with vegetation. The railroad, with its out-of-date equipment and inefficient personnel, was in a state of extreme deterioration. Aside from the few hundred laborers left by the French company there was not even the nucleus of an organization.

These conditions were not, however, the most formidable that confronted the Commission. The entire Zone was in an ideal state for the propagation of disease, and the cities of Colon and Panama, but especially the latter, were a reproach to civilization. The French had not the authority to enforce sanitary rules in the city of Panama and in Colon only within the bounds of their own property. Their hospital system was admirable, but they were necessarily re-

stricted to the cure of sickness or the mitigation of its effects. Preventive measures against the prevailing diseases were impossible to them, owing to ignorance of causes. Malaria was attributed to miasmic exhalations from the soil, and yellow fever to an ever-present poison. Under the circumstances it is not surprising that the casualties during the French occupancy ran into extremely high figures.

WE HAVE GREATER OPPORTUNITIES THAN HAD THE FRENCH.

Our latter-day knowledge enables us to adopt more effective measures and affords ground for the hope that we shall rid the Canal Zone of yellow fever, and reduce malaria to an insignificant factor. The mosquito theory has been extensively tested, and its truth may be said to be established. The experiences of Havana, New Orleans, and other places seem to prove it. A few years ago the abandonment of Ismalia as headquarters of the Suez Canal was seriously considered on account of the general sickness of the European residents. Among 2,000 of these there were 1,400 cases of malarial fever annually, many of which resulted in death. In 1902 the mosquitoes were extirpated and their breeding places destroyed. The number of cases of malaria since has been 214 in 1903, 90 in 1904, and, during ten months of 1905, 46, without a death in the whole

period. Those who have had malaria subsequent to the sanitating of the place had been chronic sufferers from the disease previously.

The inhabitants of Panama are immune to yellow fever, but until recently the disease has never been absent from the Isthmus when there have been any non-immunes to contract it. During the twenty-five years since the inception of the French enterprise there has, on several occasions, been an influx of non-immune persons, and on each such occasion there was a large increase in the mortality from yellow fever. The rule held good continuously until full effect was had from the sanitary measures taken by the United States authorities in the Canal Zone. The records of the Panama cemetery are cited by our health officers as furnishing evidence of their declaration that it is not only possible but feasible to banish yellow fever from the Isthmus and to maintain the whole force of employees in a good state of health.

THE DEATH ROLL UNDER FRENCH MANAGEMENT.

Work on the Canal was commenced in 1881. In 1882 the force numbered fewer than 2,000, and in 1884 the average number employed was 17,615. The aggregate of the numbers of those reported yearly as employed in the whole period of eight years is 86,-812, or an average of 10,881 per year. The total number treated for sickness was 52,814. The num-

ber of deaths of employees in the same period was 5,627, showing a rate of mortality among the sick of 10.62 and among the employed of 6.48 per cent.

The popular clamour to see "the dirt fly" induced the first Isthmian Canal Commission to attack the task of excavation before the essential one of preparation had been accomplished. The consequence was a sudden excess of mortality and sickness, resulting in panic and disorganization. The present Commission wisely determined to defer digging until such time as the Zone shall be rendered thoroughly sanitary, the organization and equipment adequate, the laborers properly housed and sufficiently fed. The work will then proceed to a rapid and successful conclusion without interruption.

Disease, graft, and mismanagement were the three great factors in the failure of the French. Not the least of these was disease, which on two occasions necessitated a cessation of the operations. Business policy, as well as humane considerations, demanded the sanitation of the Zone by us. Had we neglected this duty the work of construction must have been greatly retarded and very much enhanced in cost. Not only that, but the completed Canal, if in an unhealthy region, will be shunned by the commerce it is designed to attract.

The treaty between the United States and Panama conveyed to the former a strip of territory ten miles in width, extending forty-two miles from sea to sea.

Its boundaries embrace twenty-five towns and a number of camps besides the cities of Panama and Colon. These last, although topographically within the Canal Zone, were not included in the concession, but the terms of the convention specifically permit us to exercise discretionary control over them in matters of sanitation and order. The agreement provides for the repayment to the United States by the Panama Republic, of all expenses incurred by the former in these respects.

FORMER CONDITION OF PANAMA AND COLON.

When we took over the Canal the entire Zone was covered with rank vegetation and stagnant pools in which the anopheles, the malaria mosquito, bred undisturbed. The City of Panama had neither sewer nor drainage system. Its streets were paved with cobble-stones and lined with gutters through which the refuse of the dwellings trickled slowly, and in places stood for days and weeks at a time. The inhabitants depended for their water supply upon rain, which was stored in open cisterns or barrels. These receptacles were the most fertile breeding places of the stegomyia, or yellow-fever mosquito.

The low, sandy island on which Colon is built is nowhere more than four feet above mean sea level, and high tides cover considerable portions of it. Of course no adequate drainage system could exist under

such circumstances, and the city was devoid of sewers. The small section that contained the dwellings of canal officials and employees of the railroad company was supplied with water of an indifferent quality from a reservoir near Mount Hope. The remainder of the population depended, like the people of Panama, upon rain water. The streets of Colon were in a wretched condition and the whole place in great disorder when it came into our hands. Its small population of about 6,000 has, however, rendered the task of sanitation comparatively easy. In view of the probable ultimate abandonment of Colon as the entrepot of the canal it would be an extravagant expenditure of time and money on the part of the Commission to fill in and grade the island, and particularly so as a very small proportion of the inhabitants are in the American service.

The plan of Colonel Gorgas, the chief sanitary officer, consisted mainly of the destruction of the mosquitoes and their breeding places and the treatment by the medical staff of all cases of sickness. This plan when applied to the entire Zone entailed an enormous amount of labor, and its execution was made possible only by the most constant and painstaking energy. The Panamans — who can afford to treat yellow fever lightly — tell funny stories of Gorgas's men chasing a single mosquito for hours, and after the capture solemnly executing it with a machete. Though this be a fanciful picture it is strict-

ly true that when a case of yellow fever is discovered the health officers trace it with sleuth-like persistency to its origin, without missing a link. The ingenuity and care exercised in these searches is illustrated in the following case, by no means an exceptional one.

SANITARY DETECTIVE WORK.

On his daily tour of inspection of one of the hotels in Panama a health inspector learned that a lodger had been taken ill. A search for the man proved that he had left the house. The next day he was found on the street drunk and was taken to the hospital. It was a case of yellow fever and resulted in death. Investigation showed that the hotel contained none but non-immunes, so that the deceased had evidently contracted the disease elsewhere. No one knew him or anything of his movements previous to his sickness. The enquiry was transferred to a certain café which was known to be a favorite haunt of men of the same nationality as the deceased. Here, after much questioning it was learnt that he had been seen in the company of an Italian. The inspectors set out to interrogate every Italian in the city, and at length found one who declared that he had seen the dead man with the bartender of the theatre. The bartender could not be found at his usual place of business, but diligent search discovered him in a secluded lodging, in bed and sick with

yellow fever. He said that the former victim, whilst registered at the hotel, had been sleeping with him in a room at the theatre. From this it appeared that the playhouse was the centre of infection and it was accordingly fumigated. The discovery of a third case in which the infection was traceable to the same source satisfied the health officers of the correctness of their conclusion, which was further confirmed by the fact that the outbreak was limited to the cases that have been mentioned. Under the old conditions it would probably have spread unchecked throughout the non-immune population of the city, creating a new focus of infection with each fresh case.

EXTENSIVE WORK OF THE SANITARY DEPARTMENT.

To quote Colonel Gorgas: "When one considers the five hundred square miles of fever-ridden jungle which confronted us; when one remembers that the mortality among the laborers under the French régime rose at times to the enormous figure of six hundred to the thousand annually, some idea may be gained of the magnitude of the undertaking."

In the campaign of extermination that has been vigorously waged against the mosquitoes an amount of work has been done along the line of the canal of which only a partial conception can be derived from the following statements: two million square yards of brush and grass have been cut and burnt; more

FUMIGATING BRIGADE IN PANAMA.

than one million square yards of swamp have been drained or filled in; upwards of one hundred and fifty thousand feet of ditch have been put in effective condition; three million cubic feet of house area have been fumigated. This the sanitary department describes as "only a beginning." It is a very fine beginning and one that has already borne fruit beyond any expectations that were entertained two years ago.

In addition to the sanitation of the Zone, the preparatory work of the Commission has been directed toward the establishment of permanent and sufficient food and water supplies, the erection of suitable dwellings, the installation of an adequate mechanical plant, the proper equipment of the Panama Railroad and the organization of an efficient staff of employees.

There are within the Canal Zone, exclusive of the cities of Panama and Colon, about twenty-five towns and a number of temporary camps. The water supply of each of these centres has been improved and before the close of the year 1906 pure water in abundant quantity will be readily available to every human being within the limits of the territory and in the terminal ports. Comfortable houses have been erected on carefully selected sites and are under the constant supervision of the sanitary inspectors. Emergency hospitals, schools, churches and police courts have been established along the line. The

regulation of the saloon traffic under a high license has produced marked results in the abatement of drunkenness.

THE QUESTION OF FOOD SUPPLY.

Food supply is one of the many vexing questions with which the Commission has successfully dealt. It was found that the local markets could not be depended upon to any considerable extent. Not only have the requirements increased by reason of the employment of a greater number of laborers, but the local supply has been concurrently curtailed owing to the fact that the high wages paid on the Canal are constantly attracting the natives and inducing them to abandon the cultivation of their fields. The Commission is meeting the difficulty by establishing commissary stores at convenient points where the silver employees may secure good food at low prices and on credit. In connection with these depots a system of cold storage plants will be operated and the bulk of the supplies will be imported, thus, not only insuring a constant sufficiency, but also minimizing the danger of infection from this source.

EXTRAORDINARY TREATMENT OF THE LABORERS.

All statements to the contrary notwithstanding, it is true that the laborers in the employ of the Com-

mission are receiving better treatment than they ever experienced before: indeed, it is safe to go farther and say that similar care and attention has never been bestowed on a large body of common laborers anywhere. As a matter of fact the negro on the Canal is too well treated. He is pampered and his natural inefficiency is consequently increasing. He lives in a model tenement which is a palace in comparison with his Jamaican shack. He has good food and excellent medical attendance. He works when he thinks fit, and loafs when he pleases. Every few months he goes jauntily back to Jamaica to spend his savings, but he seldom fails to return to the Isthmus. If we could substitute even a fairly good grade of labor for the present supply, the completion of the Canal might be accelerated by two or three years and its ultimate cost decreased by several millions.

During the summer of 1906, every house in Panama and Colon, without a single exception, was fumigated. So far as the authority of the Commission can be reasonably exerted, every building in those cities is now screened and every dwelling, hotel and lodging-house is subjected to daily inspection. It should be said to the credit of the citizens of Panama, who are immune to yellow fever, that they have cheerfully submitted to the inconvenience and discomfort entailed by these measures of sanitation. The Panaman is shrewd and intelligent. He is not

slow to appreciate the prospective advantages to be enjoyed by his country in consequence of our improvements. One of the most immediate results must be a great enhancement in real estate values in Panama, La Boca and Colon. Such a movement will redound to the benefit of the United States, which, as the owner of the Panama Railroad, has title to a great deal of property in those cities.

IMPROVEMENTS IN THE CITY OF PANAMA.

The city of Panama is far advanced in the process of transformation that will convert it into an attractive and healthful place. A considerable portion of the city was supplied with pure water eight months ago and before these lines are in print the system will be complete. It is very extensive, designed not only to afford a practically unlimited supply to the present inhabitants, but also to meet the requirements of considerable expansion. The people of Panama know for the first time what modern sewerage is and they are beginning to appreciate good pavement as the work of laying the thoroughfares with vitrified brick progresses.

A similar change is taking place in La Boca. One-half of the town is owned by the United States. In that section the old-time ramshackle buildings have given place to new or remodelled houses, freshly painted, lighted by electricity, supplied with good

water and sewers. The streets have been improved, and the wharving facilities have been greatly increased. The action of the Commission in its quarter of La Boca must force private owners of property to follow suit as soon as the requisite workmen are available.

During the year 1905 two separate outbreaks of bubonic plague occurred in La Boca and by the energetic measures of the health department each was confined to the original case. This is an achievement to be proud of, for the disease is probably the most virulent and quick-spreading known.

CONDITIONS IN THE CITY OF COLON.

The residents of Colon smile at the hysterical vaporings of recent writers who have been moved to tearful protest against the condition of the place. Since the French operations began the Canal employee who was stationed at Cristobal or Colon — they are in reality one — has considered himself fortunate in the place of his abode and would not willingly change it for any other on the Isthmus. It will readily be imagined from what has already been said with respect to it, that Colon is not pleasing to the eye, with a swamp on one side and an invading tide upon the other, but these are conditions which until quite recently were markedly pronounced at Atlantic City, said to be the most salubrious spot in

the United States. The Colonite will tell you that he is not especially concerned about appearances, but that it is very gratifying to know that his city has a health record forty per cent better than that of Panama.

Colon cannot be effectively drained until the swamp is filled in and that is a task which must necessarily wait upon excavation elsewhere, if, indeed, it is found advisable to undertake it at all. Meanwhile the streets are being rapidly graded and finished with Telford pavement. A canal is in process of construction through the town. This will give continuous passage to fresh sea water and will receive surface drainage. The section inhabited by the Canal employees has had the advantage of a complete domestic system of sewerage for some time. In the near future the entire city will be sewered for house drainage into a large cesspool, the contents of which will be pumped far out to sea. Colon has an ample supply of water from two permanent standpipes with an aggregate capacity of nearly one million gallons.

THE OPINIONS OF AN EXPERT.

The popular impression of the work of the Commission upon the Isthmus has been derived generally from unreliable sources. We have had the stories of scared "quitters" and disgruntled incompetents, who have either been wanting in courage or capacity, but

there has been little apparent effort to secure the testimony of men whose experience entitles them to speak with authority.

In a letter dated February 13, 1906, and addressed to the writer, Mr. W. Henry Hunter, the Chief Engineer of the Manchester Ship Canal, made the following remarks:

"During my recent visit to the Isthmus of Panama I had, together with the other members of the Board of Consulting Engineers, opportunity for somewhat close observations of the conditions which now exist in the portion of the Isthmus which is subject to the control of the Isthmian Canal Commission.

"The days of compulsory labor have, happily, long since passed away; if therefore the construction of the Panama Canal is to proceed with economy and despatch, it is essential that labor, both of a skilled and of an unskilled sort, should be attracted to the Isthmus, and consequently essential that the conditions in the Canal Zone should be made such as will prove attractive to reasonable and intelligent men.

"The initial work required for this purpose was naturally divided into two great heads: 1. Sanitation. 2. Housing of employees.

"1. The work of sanitation, i. e., that required to render the Isthmus a *safe* place of habitation, has, since the American Government obtained possession of the Isthmus, been taken in hand in the vigorous, efficient and workmanlike manner which those who

know Colonel Gorgas expected from him, and from those working under his direction.

"The work which has already been accomplished has proved entirely successful, and I have no doubt but that Colonel Gorgas and his staff will effectually stamp out the peril of yellow fever, and will reduce to a minimum the more subtle, though less apparent, dangers from malaria.

"2. The work of housing, i. e., that required to make the Canal Zone a *comfortable* place of residence, is being proceeded with in the same vigorous and effective manner.

"Quarters are being provided for all classes of labor, in which workmen may dwell under conditions which will compare favorably, both in respect of health and of comfort, with many workmen's habitations in large cities both in America and in Europe.

MR. HUNTER IS FAVORABLY IMPRESSED WITH CONDITIONS.

"Taken all together I was favorably impressed with the conditions which exist in the Canal Zone.

"It appeared to me that when the provision of the necessary plant and the construction of the transportation railroads have been completed, no obstacle in the way of putting forth of strenuous and energetic effort for the removal of the excavation from the Canal prism will remain.

"This plant, so far as the work in the dry is concerned, is being provided and delivered on the ground and the roads are being laid in, so that I see no reason why the dry excavation work should not be commenced almost immediately."

Mr. John N. Popham, a native of Virginia, has been engaged in railroad building and other enterprises on the Isthmus for many years past. Upon the occasion of a recent visit to the United States he made the following statement:

"Prior to last May (i. e., May, 1905) the conditions on the Isthmus may have been open to just and intelligent criticism, caused by the delay in improving the physical condition of the Panama Railroad, purchase of necessary rolling stock, and improving the terminal facilities. But those conditions are forgotten history. The fair-minded residents of the Isthmus appreciate the magnificent efforts and splendid results accomplished since that time.

THE PANAMANS ARE SATISFIED WITH THE SITUATION.

"The statement made by Mr. Poultney Bigelow is so far from being fair, the views so distorted, and the inference so frail, that it is only laughed at on the Isthmus, and it was so fully covered at home by that part of the President's communication to Congress the 8th instant, under the heading of 'Scandal-

mongers,' that there is little left for a self-respecting American resident of the Isthmus to add. The people of Panama are intelligent, capable people. They appreciate the results accomplished: they have been and are anxious and willing to continue to help our people in the great enterprise that means so much to the whole world.

THE LABORERS ARE WELL TREATED.

"After sixteen years experience on and in the vicinity of the Isthmus and knowing, as I do, the homes of the West India laborers in the great banana-producing districts near Colon, and having for many years employed from 400 to 700 Jamaicans daily at our mines, thirty-five miles from Colon, I feel competent to judge and to tell you that the West India laborer has never known and in his most pleasant dreams has never hoped for, the splendid care and liberal treatment he is receiving from our government on the Isthmus of Panama.

"My knowledge of the affairs of the Canal company only enables me to speak of conditions on the Isthmus and the work in progress there. But in every department of the Canal work during the past seven months on the Isthmus the people of this country can rest assured that the investigation to be made by the Senate committee will confirm the following lines found in the President's communication to Con-

gress: 'The work on the Isthmus is being admirably done, and great progress has been made.'"

The cost of the operations on the Isthmus has afforded subject for facetious articles and comic cartoons in the public press. Let us look at some of the items of expenditure and we shall thereby improve our conception of the greatness of the enterprise, and of the complexity of its details.

In June, 1902, Congress appropriated $10,000,000 for the use of the Canal Commission and all expenses up to the close of the year 1905 were paid out of that amount. The purchases range over the greatest variety and degrees of magnitude, from steamships to handcuffs. Four million dollars has been paid for general supplies, including fuel, explosives, lumber, machinery, roofing, paving and plumbing material, medical and sanitary supplies, garbage carts, laundry equipment, steel vaults, scientific instruments, and other innumerable and diversified items. During 1905, upwards of one million dollars was laid out on steel flat cars, half a million on steam shovels and three times as much on locomotives.

A CLEAN AND WELL-DIRECTED MANAGEMENT.

The Commission has observed strict business principles in all these purchases. There has been no opportunity for graft and hence without doubt has arisen a great deal of the dissatisfaction expressed with its management.

The conduct of the enterprise so far should be a source of pride to Americans. There have been mistakes, of course, but no blunders. Errors of judgment and miscalculations have been quickly recognized and rectified. Not a justifiable suspicion of graft has been connected with the operation since it came into American hands. Influence and favoritism have been singularly absent from the appointments. The men at the head of affairs have nothing but reputation to gain from the undertaking and it is not their purpose to allow incompetents to hazard their prospects in that respect. As the conditions of life on the Isthmus become more healthful and comfortable greater pressure will doubtless be exerted by the drones who attach to the skirts of Congressmen and officials, but it is safe to predict that as long as the present Executive Committee of the Commission retain their positions such efforts will be unavailing.

THE COMMON SENSE OF THE SITUATION.

We approach the construction stage of the undertaking with the management of the enterprise in thoroughly capable hands, supported by an experienced and efficient staff. The organization is admirably calculated to work harmoniously, for the heads of departments have been at pains to secure the services of men who had been associated with them in

former important works and with whose characters and capabilities they are familiar. In many cases these men are making sacrifices in thus accepting service under their old chiefs, for the salaries are not such as to attract first-class men under the circumstances that surround life on the Isthmus at its best.

The Commission deserves the support of the American people and press. Common sense demands that we refrain from the puerile nagging and fault-finding which has hitherto been our only reward for honest, energetic and patriotic work. The present Congressional investigation will prove that we have been acting a very ungrateful part. At the close of it we should open a new chapter in the history of the Canal. There should be a cessation of slander and obstruction and a disposition toward truth and fair play.

APPENDIX

GREAT CANALS OF THE WORLD.

APPENDIX.

GREAT CANALS OF THE WORLD.*

The Suez Canal — The Cronstadt and St. Petersburg Canal — The Corinth Canal — The Manchester Ship Canal — The Kaiser Wilhelm Canal — The Elbe and Trave Canal — Canals Projected in Prussia — Ship Canals Connecting the Great Lakes of North America — The Welland Canal — The Sault Ste. Marie Canals — Lake Borgne Canal — The Chicago Sanitary and Ship Canal — Other Canals — Canals of the United Kingdom — Canals of the United States — The Economic Effects of Ship Canals — Canals of Holland — Manchester Ship Canal — Effect of Suez Canal on Shipping — Traffic of Suez and St. Mary's Canals Compared — Changes in the Lakes Shipping — Effect of "Soo" Canal on Iron Business — Enormous Wheat Traffic of the Lakes — Influences of St. Mary's and Suez Canals — Canals in China — The Canal System of India.

Ship canals connecting great bodies of water, and of sufficient dimensions to accommodate the great modern vessels plying upon such waters, are of comparatively recent production and few in number. The one great example of works of this character which has been a sufficient length of time in existence and operation to supply satisfactory data as to cost of maintenance and operation and practical value

* The following matter is extracted from the monograph under this title issued by the Department of Commerce and Labor, Washington, D. C.

to the commerce of the world is the Suez Canal, and for this the available statistics begin with the year 1870, while its new and enlarged dimensions only date from the year 1896. For the Sault Ste. Marie Canal, connecting Lake Superior with Lake Huron, statistics date from 1855. Statistics of the Welland Canal date from 1867, but for the canal in its present enlarged form cover but four years of operation. The other great ship canals of the world are of much more recent construction, and data regarding their operation therefore cover a comparatively brief term, and in some cases are scarcely at present available in detail.

The artificial waterways which may properly be termed ship canals are nine in number, viz.:

(1) The Suez Canal, begun in 1859 and completed in 1869.

(2) The Cronstadt and St. Petersburg Canal, begun in 1877 and completed in 1890.

(3) The Corinth Canal, begun in 1884 and completed in 1893.

(4) The Manchester Ship Canal, completed in 1894.

(5) The Kaiser Wilhelm Canal, connecting the Baltic and North Seas, completed in 1895.

(6) The Elbe and Trave Canal, connecting the North Sea and Baltic, opened in 1900.

(7) The Welland Canal, connecting Lake Erie with Lake Ontario.

(8 and 9) The two canals, United States and Canadian, respectively, connecting Lake Superior with Lake Huron.

THE SUEZ CANAL.

The Suez Canal is usually considered the most important example of ship canals, though the number of vessels passing through it annually does not equal that passing through the canals connecting Lake Superior with the chain of Great Lakes at the south. In length, however, it exceeds any of the other great ship canals, its total length being 90 miles, of which about two-thirds is through shallow lakes. The material excavated was usually sand, though in some cases strata of solid rock from 2 to 3 feet in thickness were encountered. The total excavation was about 80,000,000 cubic yards under the original plan, which gave a depth of 25 feet. In 1895 the canal was so enlarged as to give a depth of 31 feet, a width at the bottom of 108 feet and at the surface of 420 feet. The original cost was $95,000,000, and for the canal in its present form slightly in excess of $100,000,000.

The revenue of the canal is apparently large in proportion to its cost, the latest report of the company for 1903 giving the net profits for that year at 65,579,347 francs, and the total amount distributed among the shareholders 64,565,634 francs, or over

12 per cent of the estimated cost of $100,000,000. The canal is without locks, being at sea level the entire distance. The length of time occupied in passing through the canal averages about eighteen hours. By the use of electric lights throughout the entire length of the canal passages are made with nearly equal facility by night or day. The tolls charged are 8.50 francs per ton net register, "Danube measurement," which amounts to about $2 per ton United States net measurement. Steam vessels passing through the canal are propelled by their own power.

The canal has accommodated the following traffic since its opening:

	Vessels.	Gross Tonnage.
1870	486	654,915
1875	1,494	2,940,708
1880	2,026	4,344,519
1890	3,389	9,749,129
1895	3,434	11,833,637
1900	3,441	13,699,237
1903	3,761	16,615,309

THE CRONSTADT AND ST. PETERSBURG CANAL.

The canal connecting the Bay of Cronstadt with St. Petersburg is described as a work of great strategic and commercial importance to Russia. The canal and sailing course in the Bay of Cronstadt are about 16 miles long, the canal proper being about 6

miles and the bay channel about 10 miles, and they together extend from Cronstadt, on the Gulf of Finland, to St. Petersburg. The canal was opened in 1890 with a navigable depth of 20½ feet, the original depth having been about 9 feet; the width ranges from 220 to 350 feet. The total cost is estimated at about $10,000,000.

THE CORINTH CANAL.

The next of the great ship canals connecting bodies of salt water in the order of date of construction is the Corinth Canal, which connects the Gulf of Corinth with the Gulf of Ægina. The canal reduces the distance from Adriatic ports about 175 miles and from Mediterranean ports about 100 miles. Its length is about 4 miles, a part of which was cut through granite soft rock and the remainder through soil. There are no locks, as is also the case in both the Suez and Cronstadt canals, already described. The width of the canal is 72 feet at bottom and the depth 26¼ feet. The work was begun in 1884 and completed in 1893 at a cost of about $5,000,000. The average tolls are 18 cents per ton and 20 cents per passenger.

THE MANCHESTER SHIP CANAL.

The Manchester Ship Canal, which c

chester, England, with the Mersey River, Liverpool, and the Atlantic Ocean, was opened for traffic January 1, 1894. The length of the canal is 35½ miles, the total rise from the water level to Manchester being 60 feet, which is divided between four sets of locks, giving an average to each of 15 feet. The minimum width is 120 feet at the bottom and average 175 feet at the water level, though in places the width is extended to 230 feet; the minimum depth 26 feet, and the time required for navigating the canal from five to eight hours. The total amount of excavation in the canal and docks was about 45,000,000 cubic yards, of which about one-fourth was sandstone rock. The lock gates are operated by hydraulic power; railways and bridges crossing the route of the canal have been raised to give a height of 75 feet to vessels traversing the canal, and an ordinary canal whose route it crosses is carried over it by a springing aqueduct composed of an iron caisson resting upon a pivot pier. The total cost of the canal is given at $75,000,000. The revenue in 1902, according to the Statesman's Yearbook, was £358,491, and the working expenses, £217,537.

THE KAISER WILHELM CANAL.

Two canals connect the Baltic and North seas through Germany, the first, known as the Kaiser Wilhelm Canal, having been completed in 1895 and

constructed largely for military and naval purposes, but proving also of great value to general mercantile traffic. Work upon the Kaiser Wilhelm Canal was begun in 1887, and completed, as above indicated, in 1895. The length of the canal is 61 miles, the terminus in the Baltic Sea being at the harbor of Kiel. The depth is 29½ feet, the width at the bottom 72 feet, and the minimum width at the surface 190 feet. The route lies chiefly through marshes and shallow lakes and along river valleys. The total excavation amounted to about 100,000,000 cubic yards, and the cost to about $40,000,000. The number of vessels passing through the canal in 1903–4 was 32,038, with a tonnage of 4,990,287, and the dues collected amounted to 2,414,499 marks.

THE ELBE AND TRAVE CANAL.

A smaller canal, with a length of about 41 miles and a depth of about 10 feet, was opened in 1900, known as the Elbe and Trave Canal, and is described by the International Yearbook, 1900, as follows:

"The Elbe and Trave Canal, in Germany, was opened by the Emperor of Germany on June 16, 1900. It has been under construction for five years, and has cost about $5,831,000, of which Prussia contributed $1,785,000 and the old Hanse town of Lubeck $4,046,000. The length of the new canal is about 41 miles, and is the second to join the North

Sea and the Baltic, following the Kaiser Wilhelm Canal (or Kiel Canal), built about five years ago at a cost of $37,128,000. The breadth of the new canal is 72 feet; breadth of the locks, 46 feet; length of locks, 261 feet; depth of locks, 8 feet 2 inches. It is crossed by 29 bridges, erected at a cost of $1,000,000. There are seven locks, five being between Lubeck and the Mollner See (the summit point of the canal) and two between Mollner See and Fauenberg-on-the-Elbe. At this point it may be noted that the Germans began experiments during 1900 with electric towing on the Finow Canal between Berlin and Stettin. A track of 1-meter gauge was laid along the bank of the canal, having one 9-pound and one 18-pound rail laid partly on cross-ties and partly on concrete blocks. The larger rail serves for the return current, and has bolted to it a rack which gears with a spur wheel on the locomotive. The locomotive is 6 feet 10 inches by 4 feet 10 inches, mounted on four wheels, with a wheel base of 3 feet 6 inches, and weighing 2 tons. It is fitted with a 12-horsepower motor, current for which is furnished by a 9-kilowatt dynamo, driven by a 15-horsepower engine. The current is 500 volts, and is transmitted by a wire carried on wooden poles 23 feet high and about 120 feet apart. The boats are about 132 feet long and 15 feet 6 inches beam, and carry from 150 to 175 tons on a draft of 4 feet 9 inches. During 1900 the Stettin-Swinemund Canal, with a length of 35 miles, has been dredged through-

out, and is now open to steamers drawing 22 feet of water. Swinemund is on the Baltic Sea.

"Among the various projects for European canals may be mentioned one connecting the Danube a little below Vienna, Austria, with the Adriatic Sea at Trieste, a distance of about 319 miles. The construction will cost some $120,000,000. Late in 1900 a canal from Liege to Antwerp, in Belgium, was being seriously discussed, in order to connect the prosperous city of Liege with the sea, and make it, like the city of Manchester, England, a seaport. The promoters propose a canal 84 miles long, 200 feet wide, and 23 feet deep from Antwerp to Liege, with locks at Liege, Hasselt, Herenthals, and Antwerp. The difference in level to be overcome by locks would be 175 feet, and it is thought that thirteen single locks and one double lock would be sufficient. The total estimated cost of the work is $25,200,000."

CANALS PROJECTED IN PRUSSIA.

According to a recent report of United States Consul-General Guenther, of Frankfort, Germany, the committee on canals of the Prussian Diet has reported, with a favorable recommendation, a bill providing for the following construction:

1. A navigable canal between the rivers Rhine and Weser, with a connection to Hanover, and the canalization of the River Lippe:

(*a*) A navigable canal from the Rhine in the vicinity of Ruhrort, or from a more northern point, to the Dortmund-Ems Canal or the vicinity of Herne (Rhine-Herne Canal) inclusive of a branch canal from Datteln to Hamm; estimated cost, 74,500,000 marks ($17,731,000).

(*b*) Several additional works on the Dortmund-Ems Canal between Dortmund and Bevergern; estimated cost, 6,150,000 marks ($1,463,700).

(*c*) A navigable canal from the Dortmund-Ems Canal in the vicinity of Bevergern to the River Weser, connecting with Hanover; branch canals to Osnabrück, Minden, and Linden, construction of reservoirs in the upper parts of the River Weser and some regulation works of the Weser below Hameln; estimated cost, 120,500,000 marks ($28,679,000).

(*d*) Canalization of the River Lippe or construction of branch canals of the Lippe from Weser to the Dortmund-Ems Canal, near Datteln, and from Hamm to Lippstadt; estimated cost, 44,600,000 marks ($10,614,800).

(*e*) Improvement of the cultivation of the soil in connection with the works under items *a* to *d*, and the completed Dortmund-Ems Canal; estimated cost, 5,000,000 marks ($1,190,000).

The total estimated cost of the work, items *a* to *e*, is placed at 250,750,000 marks ($59,678,500).

2. The construction of a deep waterway between

Berlin and Stettin; estimated cost, 43,000,000 marks ($10,234,000).

3. Improvement of the waterway between the rivers Oder and Weichsel, also of the river Warthe from the mouth of the river Netze to the city of Posen; estimated cost 21,175,000 marks ($5,039,-650).

4. The canalization of the river Oder from the mouth of the river Glatzer Neisse to the city of Breslau, experimental works on the line between Breslau and Fürstenberg and the Oder, construction of one or of several reservoirs; estimated cost, 19,-650,000 marks ($4,676,700).

The entire cost of the projects named is placed at 334,575,000 marks ($79,628,850).

SHIP CANALS CONNECTING THE GREAT LAKES OF NORTH AMERICA.

Three ship canals intended to give continuous passage to vessels from the head of Lake Superior to Lake Ontario and the St. Lawrence River are the Welland Canal, originally constructed in 1833 and enlarged in 1871 and 1900; the St. Marys Falls Canal at Sault Ste. Marie, Mich., opened in 1855 and enlarged in 1881 and 1896, and the Canadian Canal at St. Marys River, opened in 1895. In point of importance, measured at least by their present use, the canals at the St. Marys River by far surpass that

of the Welland Canal, the number of vessels passing through the canals at the St. Marys River being eight times as great as the number passing through the Welland, and the tonnage of the former nearly forty times as great as that of the latter. One of the important products of the Lake Superior region, iron ore, is chiefly used in the section contiguous to Lake Erie, and a large proportion of the grain coming from Lake Superior passes from Buffalo to the Atlantic coast by way of the Erie Canal and railroads centering at Buffalo. The most important article in the westward shipments through the Sault Ste. Marie canals, coal, originates in the territory contiguous to Lake Erie. These conditions largely account for the fact that the number and tonnage of vessels passing the St. Marys River canals so greatly exceed those of the Welland Canal.

THE WELLAND CANAL.

The Welland Canal connects Lake Ontario and Lake Erie on the Canadian side of the river. It was constructed in 1833 and enlarged in 1871 and again in 1900. The length of the canal is 27 miles, the number of locks 25, the total rise of lockage 327 feet, and the total cost about $25,000,000. The annual collection of tolls on freight, passengers, and vessels averages about $225,000 and the canal is open on an average about 240 days in a year. By order

in council dated April 27, 1903, the levy of tolls for passage through Dominion canals has been abolished for a period of two seasons of navigation.

THE SAULT STE. MARIE CANALS.

The canals at Sault Ste. Marie, Mich., and Ontario are located adjacent to the falls of the St. Marys River, which connects Lake Superior with Lake Huron, and lower or raise vessels from one level to the other, a height of 17 to 20 feet. The canal belonging to the United States was begun in 1853 by the State of Michigan and opened in 1855, the length of the canal being 5,674 feet, and provided with two tandem locks, each being 350 feet in length and 70 feet wide, and allowing passage of vessels drawing 12 feet, the original cost being $1,000,000. The United States Government, by consent of the State, began in 1870 to enlarge the canal, and by 1881 had increased its length to 1.6 miles, its width to an average of 160 feet, and its depth to 16 feet; also had built a single lock 515 feet long and 80 feet wide, with a depth of 17 feet on the sills, which was located 100 feet south of the State locks. The State relinquished all control of the canal in March, 1882. In 1887 the State locks were torn down and replaced by a single lock 800 feet long, 100 feet wide, with a depth of 22 feet of water on the sills. This lock was put in commission in 1896. The canal was also deepened to 25

feet. The Canadian canal, 1⅛ miles long, 150 feet wide, and 22 feet deep, with lock 900 feet long, 60 feet wide, with 22 feet on the miter sills, was built on the north side of the river during the years 1888 to 1895. In 1900 the number of vessels passing through the United States canal was 16,144, and through the Canadian canal, 3,003, showing an increase of 1,350 in the number of vessels passing through the Canadian canal, and a decrease of 1,901 in the number through the United States canal, the increase in the number passing through the Canadian canal having been due to the development of the Michipocoten district. The tonnage passing through the United States canal in 1903 was: Registered tonnage, 22,998,864 tons, against 19,901,463 in the year 1900; the freight tonnage in 1903 was 29,172,252 tons, against 23,251,539 tons in 1900. The Canadian canal shows: Registered tonnage in 1903, 4,737,580 tons, against 2,160,490 in 1900; and freight tonnage in 1903, 5,502,185 tons, against 2,018,999 in 1900. A marked contrast between the business of the St. Marys Falls and Welland canals is found in a comparison of their figures for a term of years. The number of vessels passing through the Welland Canal in 1873 was 6,425, and in 1902, 1,568, a reduction of over 75 per cent in the number of vessels. The number of vessels passing through the St. Marys Falls Canal in 1873 was

2,517, and in 1903, through the American and Canadian canals, 18,596.

The following, supplied by the office of the Chief of Engineers, War Department, shows the details of the Sault Ste. Marie and Welland canals:

The total cost of the St. Marys Falls Canal, Michigan, and of the locks now in service is $6,033,533, made up as follows:

	Dollars.
Canal	2,250,786
Weitzel lock	983,355
Poe lock	2,799,392

The length of the canal is 1.6 miles, depth 25 feet, and width varying from 110 to 1,000 feet. The size of the locks is as follows:

	Feet.
Weitzel lock:	
Depth of water at mean stage	17
Length between gates	515
Width of chamber	80
Width at gates	60
Poe lock:	
Length between gates	800
Depth of water at mean stage	22
Width	100

The lift of both locks varies from 16 to 20 feet.

The Canadian lock at Sault Ste. Marie, Ontario, Canada, has a length between gates of 900 feet and

a width of 60 feet; the depth of water over miter sill of lock and in canal is 22 feet at mean stage (20 feet 3 inches at lowest known water level). The total amount expended on construction to June 30, 1900, was $3,770,621.

The Welland Canal is 26.75 miles long and 100 feet wide; it has 25 lift locks and one guard lock; the locks are 270 feet long, 45 feet wide, and have a depth of water of 14 feet; the total lift is 326.75 feet. The total amount expended on construction to June 30, 1900, was $24,293,587.

According to the International Yearbook, 1900, the most notable occurrence of the year 1899 in canal construction was the opening of the Soulanges Canal by which the Canadian Government completes the last link in its long-projected 14-foot waterway from the head of Lake Superior to the mouth of the St. Lawrence River.

LAKE BORGNE CANAL.

The Lake Borgne, Louisiana, Canal was formally opened in August of 1901. It opens continuous water communication with lakes Maurepas, Pontchartrain, and Borgne, the Mississippi Sound, Mobile, and the Alabama and Warrior rivers, and the entire Mississippi River system, and has an important bearing as a regulator of freight rates between these sections. The effects of the canals may be

briefly summed up as: Shortening the distance between New Orleans and the Gulf points east of the Mississippi; bringing shipments from the Gulf coast direct to the levees at New Orleans; saving the transshipment of through freights, with a consequent reduction in freight rates; enabling sea-going vessels, drawing 10 to 12 feet of water, to come within 20 miles of New Orleans, saving all such craft the cost of tonnage and shortening, by 60 miles, direct water communication between New Orleans and the deep water of the Gulf. In addition to these effects may be enumerated the cheapening of coal for consumption at New Orleans. Coal has hitherto been floated down the rivers from Pittsburg, a distance of 2,100 miles. The canal opens up the coal fields in the interior of Alabama for New Orleans consumption and reduces coal prices considerably, giving an additional advantage to domestic industries and to steamers purchasing bunker coal. The canal is 7 miles long and from 150 to 200 feet in width. Bayou Dupre forms a portion of the canal. The lock chamber is 200 feet long, 50 feet wide, and 25 feet deep, and connects the canal with the Mississippi River.

THE CHICAGO SANITARY AND SHIP CANAL.

The Chicago Sanitary and Ship Canal connects Lake Michigan at Chicago with the Illinois River at Lockport, a distance of 34 miles. The canal was

cut for the purpose of giving to the city of Chicago proper drainage facilities by reversing the movement of water, which formerly flowed into Lake Michigan through the Chicago River and turning a current from Lake Michigan through the Chicago River to the Illinois River at Lockport and thence down the Illinois River to the Mississippi. The minimum depth of the canal is 22 feet, its width at bottom 160 feet, and the width at the top from 162 to 290 feet, according to the class of material through which it is cut. The work was begun September 3, 1892, and completed and the water turned into the channel January 2, 1900. The flow of water from Lake Michigan toward the Gulf is now at the rate of 360,000 cubic feet per minute, and the channel is estimated to be capable of carrying nearly twice that amount. The total excavation in its construction included 28,500,000 cubic yards of glacial drift and 12,910,000 cubic yards of solid rock, an aggregate of 41,410,000 cubic yards. In addition to this the construction of a new channel for the Desplaines River became necessary in order to permit the canal to follow the bed of that river, and the material excavated in that work amounted to 2,068,659 cubic yards, making a grand total displacement in the work of 43,478,659 cubic yards of material which, according to a statement issued by the trustees of the sanitary district of Chicago, would, if deposited in Lake Michigan in 40 feet of water, form an island 1 mile

square with its surface 12 feet above the water line.

All bridges along the canal are movable structures. The total cost of construction, including interest account, aggregated $34,000,000, of which $21,379,675 was for excavation and about $3,000,000 for rights of way and $4,000,000 for building railroad and highway bridges over the canal. The city and State authorities by whom the canal was constructed are now proposing to Congress to make this canal a commercial highway in case Congress will increase the depth of the Illinois and Mississippi rivers to 14 feet, with locks for fleets of barges from Lockport, the terminus of the drainage canal, to St. Louis. This, it is argued, would give through-water transportation from Lake Michigan to the Gulf by way of the drainage canal, the Illinois River, and the Mississippi River, and would enable the United States in case of war to quickly transport light-draft war vessels from the Gulf to the lakes. This work of d ening the Illinois River would also give thro water connection from Rock Island, on the U Mississippi River, to Lake Michigan via the Illi and Mississippi Canal, elsewhere described, wh extends from Rock Island, on the Mississippi Riv to Hennepin, on the Illinois River. The estima of the Chicago sanitary district trustees of the co of deepening the Illinois and M from the terminus of the ship canal

of 14 feet is $25,000,000, including five locks and dams.

OTHER CANALS.

In addition to the above ship canals, there is a number of other important waterways worthy of mention. The great North Holland Canal, cut in 1845 from Amsterdam to Helder, a distance of 51 miles, to avoid the shoals of the Zuyder Zee, has a depth of 20 feet, a width of 125 feet at the surface, and carries vessels of 1,300 tons burden, and is described as "the chief cause of the great prosperity of Amsterdam."

The Caledonian Canal, which connects the Atlantic Ocean and North Sea through the north of Scotland, is 17 feet in depth, 50 feet in width at the bottom, and 120 feet at the surface, with a surface elevation at the highest point of 94 feet above sea level. The canal proper is 250 miles long, and the distance between the terminals over 300 miles. The cost has been stated at $7,000,000, including repairs.

The Canal du Midi, cut through France from Toulouse, on the Garonne River, to Cette, on the Mediterranean, a distance of 150 miles, is 60 feet wide, 6½ feet deep, has 114 locks, and is, at its highest point, 600 feet above the level of the sea. Its cost was $3,500,000, and it is navigable for vessels of 100 tons.

A ship canal to supply passage of seagoing vessels from Antwerp to Brussels, Belgium, a distance of about 30 miles, is under contemplation.

The Illinois and Mississippi Canal, which is to furnish a navigable waterway from the Mississippi River, at the mouth of the Rock River in Illinois, to the Illinois River, at Hennepin, Ill., and thence by river and canal to Lake Michigan, was begun in 1892, and the section between Rock Island and Hennepin is now nearing completion. The canal is about 80 feet wide, 7 feet deep, and is supplied with locks 150 feet long and 35 feet wide, capable of passing barges carrying 600 tons of freight.

The canal systems of European countries and of Canada differ from those of the United States in that they are operated in conjunction with, and made complemental to, the railway systems of those countries. Canada's six great systems of government canals afford, with the St. Lawrence River connections, important inland communications. The total length of the canals in operation is 262 miles, but the aggregate length of continuous inland navigation rendered available by them is nearly 3,000 miles. The receipts in 1903 were $230,213, and the working expenses, including repairs, $581,976. The amount expended in the construction and maintenance of these canals, including the Sault Ste. Marie Canal, to June 30, 1903, is $85,300,000. In India the

canals constructed primarily for irrigation purposes, at a cost of about $15,000,000, are utilized to a considerable extent for inland navigation. In Germany the canals, aside from the Kaiser Wilhelm, are 1,511 miles in length, and the canalized rivers 1,452 miles. In France the length of the canals in operation is 3,021 miles.

CANALS OF THE UNITED KINGDOM.

In the United Kingdom the length of canals belonging to railways is 1,139 miles, and that of canals not belonging to railways 2,768 miles. The traffic of canals belonging to the railways amounted in 1898 to 6,009,820 tons; of those not belonging to railways 33,348,573 tons. The total revenue of both classes of canals was, in the same year, £2,408,534, and the expenditure £1,764,037. The tonnage figures do not include the 1,142,477 tons carried on the Manchester Ship Canal. The London Daily Mail Yearbook for 1902 says of the canal system of England: "There are 3,520 miles of inland navigation in England and Wales, of which 1,234 miles are under the control of the railways, the London and Northwestern and Great Western railways owning nearly 700 miles between them. The paid-up capital (from all sources) of the independent canals (excluding the Manchester Ship Canal) falls little short of £20,000,000, ac-

BAY OF
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Cristo
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LIGHT
OCEAN
LIMON BAY
Playa de Flor
CERRO SANTA RITA
Pta Limon
Naranjitos
Jaramill
SIERRA
San Jose
CHAGRES
Rio
Chagres
ATLANTIC
San Andres
Pina
RIO
Rio Pina

BAY OF
MANZANILLO
Manzanillo Id.
COLON
LIGHT
Cristo
Pta Toro
LIGHT
LIMON BAY
Playa de Flor
OCEAN
CERRO SANTA RITA
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Naranjitos
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San Jose
SIERRA
CHAGRES
Rio
Chagres
San Andres
ATLANTIC
Rio
Pina
Rio Pina

Ohio Canal, from Cumberland, Md., to Washington, D. C., is 184 miles in length, with 73 locks and a depth of 6 feet. The Lehigh Coal and Navigation Company's Canal, from Coalport to Easton, Pa., is 108 miles in length, with 57 locks and a depth of 6 feet. The Morris Canal, from Easton, Pa., to Jersey City, N. J., is 103 miles in length, with 33 locks and a depth of 5 feet. The Illinois and Michigan Canal, from Chicago, Ill., to La Salle, is 102 miles in length, with 15 locks and a depth of 6 feet, and the Champlain Canal, from Whitehall, N. Y., to West Troy, is 81 miles in length, with 32 locks and a depth of 6 feet.

COST OF MAINTENANCE AND OPERATION OF CANALS.

In order to form an estimate of the cost of maintaining and operating the Isthmian Canal, the Isthmian Canal Commission obtained data bearing on this point from the Suez, Manchester, Kiel, and St. Marys Falls canals, as follows:

There are no locks on the Suez Canal, but the channel is through drifting sand for a great part of its length. The entrance to the harbor of Port Said on the Mediterranean intercepts the drift of sand discharged from the Nile and carried along the coast by the easterly current. The maintenance of the Suez Canal therefore requires a large amount of dredging and consists mainly of this class of work. The oper-

ating expenses are also large, the great traffic involving heavy costs for pilotage. The general expenses for administration have necessarily been greater for the Suez Canal than for the Kiel or Manchester canals, on account of the distance of the work from the point of central control, a disadvantage which would also attend the operation of the Isthmian Canal. The annual cost of maintenance and operation of the Suez Canal is about $1,300,000, or about $13,000 per mile.

The annual cost of maintenance and operation of the Kiel Canal is $8,600 per mile. The cost of maintenance only of the Manchester Canal is $9,500 per mile. These canals have locks and other mechanical structures, and therefore might be expected to have a higher cost of maintenance than the Suez Canal, which has none, but this appears to be more than offset by reduced cost of maintaining the prism and more economical central control. The traffic being light on these canals, the cost of pilotage and port service is small. The mechanical structures are now nearly new, and will soon require larger annual outlays for maintenance, while, with the increase of traffic, operating expenses will become larger.

The St. Marys Falls Canal, when compared with those just mentioned, is remarkable by reason of its short length, large proportion of mechanical structures, and immense traffic. Its length is about 1½ miles. Its annual traffic, limited by the severity of

the winter to a period of about eight months, is nearly three times that of the Suez Canal, eight times that of the Kiel Canal, and ten times that of the Manchester Canal. Both maintenance and operating expenses are therefore very large, amounting to from $70,000 to $90,000 per year, or $46,000 to $60,000 per mile. The annual cost per mile of maintenance and operation, however, for comparison with other canals, should be determined by considering the 18½ miles of dredged channel ways in St. Marys River as part of the canal. Then for the 20 miles of canal and canalized river the expenses per mile would be from $3,000 to $5,000 annually.

Tolls were collected by the State from 1855–1881. Since its ownership by the Government no tolls have been charged.

THE CANAL SYSTEM OF INDIA.

In a few of the colonies of the world, notably India and Ceylon, irrigation works of great value have been constructed by the colonial governments. While these have been costly, the expense has been entirely borne from colonial funds or from loans which are borne by the colonial government, and the cost has been many times repaid by the increased production of the irrigated areas. It has been estimated that the value of a single year's crop produced in the irrigated sections of India in excess of that which would have been

produced without irrigation more than equals the entire cost of the irrigation system.

Sir John Strachey, in his "India," put the cost of the Indian irrigation works up to that time at 320,000,000 rupees (present exchange value of rupee about 33 cents), and adds that the estimated value of the produce of the lands irrigated by works contructed by the government was in 1892 more than 550,000,000 rupees. These works after their construction are not only self-supporting through the charges made for the water distributed, but produce in addition to the annual expenditures a net return of about 5½ per cent on their cost. In Ceylon the colonial government has recently taken up the work of reconstruction of ancient irrigation tanks and the construction of new irrigation works, and by this process it is expected that large additions will be made to the productive area of the island. The irrigating system of India is described by Sir John Strachey as follows:

THE IMPORTANCE OF CANALS IN INDIA.

"In India the very existence of the people depends upon the regular occurrence of the periodical rains, and when they fail through a wide tract of country, and, still worse, when they fail in successive years, the consequences are terrible. The greater part of India is liable periodically to this danger, but the

country is so vast that it never happens that all parts of it suffer at the same time. Improvements in the economic condition of the people, and especially more diversity of occupation, can alone bring complete safeguards and render general famine, in its extremest form, through a great tract of country impossible. But this must be a long and gradual process. Meanwhile it has been found by experience that although the entire prevention of famines, the most destructive of all calamities, is beyond the power of any government, we can do much to mitigate them by removing obstacles which hinder commercial intercourse and which diminish the productiveness of the land. The instruments by which we can do this are roads, railways, and canals. . . .

IRRIGATION CONSTANTLY REQUIRED IN PARTS OF INDIA.

"In northern India, even in good seasons, artificial irrigation is a necessity for the successful cultivation of many of the more valuable crops, and when there is a general failure of the periodical rains there is no other means by which drought and scarcity can be prevented. A large portion of northern India is now protected by canals of greater magnitude than exist in any other country of the world. . . .

"Little of the old irrigation works of our predecessors is retained in the existing canals. Practically all of these have been made by ourselves, and the

often-repeated statement, prompted, I believe, by that strange inclination to depreciate their own achievements which often besets Englishmen, that the old canals have been more profitable than those constructed by ourselves has not the least foundation of truth.

IRRIGATION SYSTEM UNDER ENGLISH RULE.

"The most important of these works in the north-western provinces are those which distribute the waters of the Ganges and Jumna. In the winter and spring, before the Ganges has been swollen by the melting of snow in the Himalayas and when water is urgently required for agricultural operations, nearly the whole visible stream of the great river at Hardwar, where it leaves the mountains, is thrown into an artificial channel. The works on the first 20 miles of its course are in a high degree remarkable, for the canal intercepts the drainage of the Lower Himalayas and has to be carried across rivers which often become furious torrents, bringing down enormous floods. These obstacles have been overcome by various methods with a skill of which our Indian engineers may well be proud. One torrent flows harmlessly in a broad artificial bed over the canal which runs below; over another, still more formidable, with a bed more than 2 miles wide, the canal, which is virtually the whole Ganges, is carried by an aqueduct. Some 200

miles farther down, the Ganges has again become a large river, and nearly all its water is again diverted into a second canal. The two canals together are capable of discharging nearly 10,000 cubic feet of water per second; the ordinary supply of each is more than double the volume of the Thames at Teddington in average weather, and this great body of water is distributed over the country by a number of smaller channels for the irrigation of the land. The length of the main channels exceeds 1,000 miles, and there are more than 5,000 miles of distributaries.

"Three canals of smaller dimensions, but which in any other country would be looked upon as works of great magnitude, distribute in a similar way nearly the whole of the water brought by the Jumna from the Himalayas. In Bahar, the border province of the Bengal lieutenant-governorship, which in its physical character closely resembles the adjoining provinces of the northwest, another great canal is taken from the river Son.

"There are other important irrigation canals in Orissa and in Bengal; but in the latter province irrigation is not ordinarily so essential as in countries farther north, where the climate is drier and the seasons are more precarious.

GREAT ECONOMICS IN CANAL OPERATION.

"The following facts, which I take from the report

of the Indian famine commissioners, will give some idea of the value of the irrigation works of the northwestern provinces:

"'Up to the end of 1877–78 the capital outlay on completed canals had been £4,346,000. The area irrigated in that year was 1,461,000 acres, the value of the crops raised on which was estimated at £6,020,000. Half the irrigated area was occupied by autumn crops, which but for irrigation must have been wholly lost, and it may be said that the wealth of these provinces was consequently increased by £3,000,000; so that three-fourths of the entire first cost of the works was thus repaid to the country in that single year.

"'In 1891–92 the area irrigated by canals in the northwestern provinces exceeded 2,000,000 acres.'

"In the Punjab works of equal importance have been constructed to utilize the waters of the Sutlej, the Ravi, and other rivers, and their value has been as great as in the northwestern provinces.

"'During the droughts of 1877–78,' Sir Henry Cunningham tells us, 'their benefits were extended to 1,333,000 acres, the greater portion of which but for canal irrigation would have been absolutely barren. During this period the land irrigated by the two principal canals produced food grain to the amount of 300,000 tons, worth £2,000,000, and enough to keep 1,800,000 people for a year; while the non-food crops — sugar, dyes, spices, etc.— were reckoned to be

worth another £1,000,000. In other words, the value of the crops saved by the two canals in a single season was more than equal to the entire cost (£2,260,000) of the completed system.'

"The benefits described by Sir Henry Cunningham have become far greater since this passage was written. The Sirhind Canal, which distributes the water of the Sutlej throughout not only our own territories but through the native State of Patiala, Nabha, and Jhind, is a work of greater magnitude than either of the canals from the Ganges. It is capable of discharging more than 6,000 cubic feet of water per second; the length of its main channel is 540 miles, and that of its distributaries 4,700 miles, and it can irrigate 1,200,000 acres. Its cost has exceeded 40,530,000 rupees, and the direct returns to the State in 1890–91 amounted to about 4.6 per cent on the capital invested.

"Different systems of irrigation prevail in other parts of India. In central and southern India large tracts of country are dependent for their supply of water on lakes and reservoirs, known by the not very appropriate name of tanks. These are in some cases natural lakes, but oftener they have been formed by the construction of dams of masonry or earth across the outlets of valleys in the hills, and they are fed sometimes by rivers and sometimes by the rainfall of a more or less extensive area. They vary in size from ponds irrigating a few acres to lakes of several

miles in circumference. Some of them are works constructed in the times of which we have no historical record.

GREAT TANKS OF SOUTHERN INDIA.

"These are not the only means of irrigation in southern India. Work hardly inferior in importance to those of the northwestern provinces and Punjab, but on a different system, have been carried out by the British Government in the Madras Presidency for utilizing the waters of the Godaveri and Kistna rivers. At the head of each of the deltas which they form before they reach the sea a great weir, or, as it is locally called, an 'anicut,' is thrown across the river, which is diverted into irrigation canals and distributing channels, some of which are also used for navigation. A large area, with a population of nearly 2,000,000, thus obtains complete protection against failure of rain, and these works have not only been in the highest degree beneficial to the people, but very profitable to the State. In the famine of 1876–77 these irrigated tracts produced rice to the value of 50,000,000 rupees, a large part of which was available for the relief of the suffering districts. Without canal irrigation there would have been no crops at all, and the value of the produce in a single year was four times as great as the whole capital expended on the canal works by the Government. Farther south, in

Tanjore, works of a similar kind provide the means of utilizing through a large tract of country, in the delta of the Kaveri, almost the entire water supply of that river. In northern India the ordinary rental of land is doubled by irrigation, and it is often more than quadrupled in Madras.

"In the province of Sind another system prevails. Little rain falls there, and without irrigation there would be no cultivation. In the same way that agriculture in Egypt depends upon the inundation of the Nile, it depends in Sind on the floods brought down by the Indus in the season of the periodical rains. There is great room for further improvement, but the existing irrigation renders the province fairly prosperous, and gives the means of subsistence to some 2,400,000 people.

EXTENT, VALUE, AND COST OF IRRIGATING SYSTEM.

"Altogether there are in India, under the management or supervision of the British Government, some 36,000 miles of canals and other works, irrigating nearly 14,000,000 acres, or more than 21,000 square miles. Although some of the canals have been financially unsuccessful and others were incomplete, the irrigation works of India, taken as a whole, yielded in 1891–2 a net return of 5½ per cent on their cost, which amounted to about 320,300,000 rupees. It is a remarkable illustration of their great

utility that this sum falls far short of the annual value of the crops they protect. In the single year of 1891–92 the estimated value of the produce of the land irrigated by works constructed by the Government was more than 550,000,000 rupees.

"No similar works in other countries approach them in magnitude, and it is certain that no public works of nobler utility have ever been undertaken in the world."

CANALS IN CHINA.*

There are several features of the canal system of China, especially of the Imperial or Grand Canal, which can be studied with profit by the people of the United States. One of these is the use of the canal for the production of food in addition to its uses as a means of transportation. Allied to this is the use of the muck which gathers at the bottom of the waterway for fertilization. Another is the use of every particle of plant life growing in and around the canal for various purposes.

The Chinese secure a vast quantity of food of one sort or another from their canals. To appreciate the exact situation with respect to the waterways, it must be realized that the canals of China cover the plain country with a network of water. Leading from the

* Report of United States Consul Anderson, Hangchau, China.

Grand Canal in each direction are smaller canals, and from these lead still smaller canals, until there is hardly a single tract of 40 acres which is not reached by some sort of ditch, generally capable of carrying good-sized boats. The first reason for this great network is the needs of rice cultivation. During practically all of the growing season for rice the fields are flooded. Wherever a natural waterway can be made to irrigate the rice fields it is used, but, of course, from these to the canals or larger rivers there must be waterways. Where natural streams can not thus be adapted the Chinese lead water in canals or ditches to the edge of their fields and raise it to the fields of rice by the foot-power carriers which have been described so often by tourist writers. However the water is supplied to the rice, it is evident that there must be a waterway leading to the field and back to a principal stream, which is generally a branch canal. These waterways naturally take up a considerable portion of the land, and the Chinese make as profitable use of them as of the land itself.

The first use of the waterways is for fishing. The quantity of fish taken from the canals of China annually is immense. The Chinese have no artificial fish hatcheries, but the supply of fish is maintained at a high point by the fact that the flooded rice fields act as hatcheries and as hiding places for the young fish until they are large enough to look out for themselves. In the United States this fish-propagation annex to

the canals is probably neither possible nor needful in view of the work done by the State and National bureaus, but in China it is nothing less than providential.

CHINESE CANALS SUPPLY FERTILIZER.

Along the canals in China at any time may be found boatmen gathering muck from the bottom of the canal. This muck is taken in much the same manner that oysters are taken by hand on the Atlantic coast. In place of tongs are large bag-like devices on crossed bamboo poles which take in a large quantity of the ooze at once. This is emptied into the boat, and the process is repeated until the boatman has a load, when he will proceed to some neighboring farm and empty the muck, either directly on the fields — especially around the mulberry trees, which are raised for the silkworms — or in a pool, where it is taken later to the fields. From this muck the Chinese farmer will generally secure enough shellfish to pa him for his work, and the fertilizer is clear gain. The fertilizer thus secured is valuable. It is rich in nitrogen and potash and has abundant humus elements. This dredging of the canals for fertilizers is the only way by which the Chinese have kept their canals in reasonably good condition for centuries. The fertilizer has paid for itself Re-
cently there were complaints filed

ashes from the steam launches plying on the canal were injuring the muck for fertilizing purposes, and the problem has been considered a serious one by the Chinese Government.

In addition to securing fertilizers from the canals, and thus keeping the canals in condition, the farmers' help keep them purified by gathering all floating weeds, grass, and other vegetable debris that they can find upon them. Boatmen will secure great loads of water plants and grasses by skimming along the surface of the canal. The reeds growing along the canals are used for weaving baskets of several grades, and for fuel. In short, no plant life about the canal goes to waste.

UTILIZATION OF SWAMP LAND.

Where there are so many canals there is more or less swamp ground. In China this is utilized for the raising of lotus roots, from which commercial arrowroot is largely obtained. There is no reason why much of the waste swamp land in the southern portion of the United States should not be used for a similar purpose, and the commercial returns from a venture of this sort in that part of the country ought to be satisfactory. Where the canals of China widen, by reason of natural waterways or for other reasons, the expanse of water not needed for actual navigation is made use of in the raising of water nuts of several

varieties, especially what are known as water chestnuts. These nuts are raised in immense quantities. They are, strictly speaking, bulbs rather than nuts. They are rich in arrow-root and are prolific, an acre of shallow water producing far more than an acre of well-cultivated soil planted in ordinary grain or similar crops. These nuts, also, could be produced to advantage in the United States where there is land inundated for the growing season to a depth which will give ordinary water plants a chance to thrive and which is not capable of being drained for the time being. The nuts or bulbs are toothsome when roasted, and are wholesome, but probably would be more valuable in the United States for the manufactured products which can be secured from them.

There are duck farms all along the canals in China. These are profitable. Chinese canals, as a rule, considering the population upon them and their varied uses, are cleaner than canals in the United States. There are few if any factories to contaminate them. The Chinese use of certain sewage for fertilization also prevents contamination to a great extent. The canal water is used for laundry, bath, and culinary purposes indiscriminately. A canal in the United States could never be what it is in China, but the Chinese have a number of clever devices and ideas in connection with canals which can be adopted in the United States with profit.

THE ANCIENT GRAND CANAL OF CHINA.

The Grand Canal system in China has existed in almost its present shape since about the time Columbus discovered America. The Grand Canal itself, extending from Hangchau to Peking, is about a thousand miles long. Much of it is banked with stone, and all of it is in such condition that with the expenditure of a little money the system could be put upon a modern and effective basis. As it is, the canal handles practically all the internal trade of China, and this trade is far greater than its foreign trade. The coming of railroads will affect the canals somewhat, but not so much as may be imagined, for the railroads will very largely build up a trade of their own. A little money will make China's canal system in the future what it has been in the past, the greatest on earth.*

THE ECONOMIC EFFECTS OF SHIP CANALS.†

Much has been written concerning the ship canals of the world as great works of engineering; much, too, on their political and military importance; but of the part they have played in the great economic

* Mr. Anderson's closing statement is open to question when the canal system of India is considered.

† J. A. Fairlie, in Annals of the American Academy of Political and Social Science, January, 1898.

changes, the result of the marvelous development of transport industries during this last half century, it is not so easy to find definite or satisfactory accounts. At the same time vague and indefinite statements frequently made indicate that their economic importance has been significant; and, in fact, it is only as they are influential in this way that they become commercially profitable undertakings. The attempt is made in this paper to trace with some degree of precision these economic effects, showing how, in consequence of the canals, important changes have been made in business machinery, in business methods, in producing and marketing commodities, and in general economic development.

The ship canals do not form a connected part of the world's transportation system, and in consequence the economic results of each are, in the main, independent of all other canals. Furthermore, the economic importance of the different canals presents the widest variations. Each opens the way for the creation of many and extensive carrying routes; but, while the influence of some has been merely local, the consequences of others have been felt throughout the commercial and industrial world. These conditions suggest the natural method of treatment to be a consideration of each canal separately, tracing so far as possible the economic effects that have resulted from its existence.

The Amsterdam and Manchester canals, each con-

structed to serve the needs of a single port, do not present the possibilities of any large and general economic results. The Welland, Corinth, and Kiel canals have a larger field of possibilities, but their actual consequences have as yet been small. The results of these less important canals are therefore but briefly considered in this paper. The examination of the vastly more important and significant results of the Suez and St. Marys Falls canals will comprise the larger part of this study.

CANALS OF HOLLAND.

In a country as well supplied with smaller canals as Holland is, it was natural that the idea of a ship canal should present itself to Amsterdam, when the shallowness of the Zuyder Zee and other difficulties of approach were causing her to lose trade to her rival, Rotterdam. The idea soon took practical form, and in 1826 the Helder Canal, with an 18-foot channel, offered an easier approach to the Dutch port. With the development of the shipping industry the dimensions of this canal became inadequate after a few decades, while its length (50 miles) and the difficult entrance in the passes of the Texel proved additional disadvantages. To maintain the commercial position of Amsterdam the construction of a new and larger canal, built by the shortest line to the sea, was decided on, and in 1876 the North Sea Canal,

15½ miles in length and 23 feet in depth, was opened for use.

The effect of the new canal on the commerce of Amsterdam was instantaneous. For twenty years the tonnage statistics for shipping at that port had shown an almost complete stagnation, while at Rotterdam the shipping had trebled. In six years after the new canal was opened the tonnage entering and clearing at Amsterdam had more than doubled, rising from 802,000 tons in 1876 to 1,734,000 tons in 1882. In the former year the Amsterdam shipping was but little over one-quarter that of Rotterdam; in the latter year it was almost a half. Since 1882, however, the increase has been at a much slower rate, while the continued rapid upward movement of the Rotterdam figures shows that there is no falling off in the general trade. Evidently the larger and deeper draft vessels now constructed find the 23-foot channel too shallow, and an enlargement of the canal will be necessary to enable Amsterdam to retain even her existing position.

MANCHESTER SHIP CANAL.

The Manchester Ship Canal resembles the Amsterdam Canal in connecting a large city with the open sea, and in being constructed with a view to its effects on the city at its inland terminus. There is the difference, however, that the promoters of the English

canal aim not simply at retaining and developing an already existing trade, but at creating a new port. The expectation of the promoters and of the corporation of Manchester, which has bonded itself heavily to secure the completion of the canal, is that the raw materials for Manchester manufactures will be brought via the canal, this route saving the heavy expenses connected with the transfer to the railroad at Liverpool. It is perhaps too early to say whether these expectations will be realized; although the estimate of a traffic of 3,000,000 tons within two years of opening has not been fulfilled, a large trade has been developed. The canal was opened on January 1, 1894, and during the first year 1,280 seagoing vessels and 1,660 boats for coast traffic came up to Manchester. For the nine months ending September, 1896, the traffic was 1,300,000 tons, an increase of 350,000 tons over the corresponding period of the year before.* This development within three years of a trade approaching that of Amsterdam in volume is not without significance, and with a continued increase Manchester in a few years will become an important shipping port.†

Like the Manchester Canal, the Corinth and Kiel

* In 1900 it exceeded 3,000,000 tons and has steadily increased since.

† From the investor's point of view, the results of the Manchester Canal are more discouraging because of the heavy expense of construction, it being almost equal to the cost of the Suez Canal.

canals have not produced immediate effects equal to the anticipations of their promoters. The Corinth Canal was opened in October, 1893, and the total traffic at the end of December, 1895 (twenty-six months), had been but 4,589 ships, with a tonnage of 596,000 tons. The first year's operation of the Kiel Canal between the Baltic and North seas showed a record of 7,500 steamers and 9,300 sailing vessels, but these were mostly small vessels, and the receipts from tolls were under 900,000 marks, against an estimate of 5,000,000 marks.

It is evident, however, that these canals have been in operation too short a time for a full development of their possibilities. The future may demonstrate that these routes offer a net advantage to shipping on account of the saving in distances and the greater safety from shipwreck; and a considerable traffic may develop with important economic results. The Welland Canal does not seem at first sight to offer this hopeful outlook. The present 14-foot channel has been in use since 1887, yet the traffic does not exceed 1,000,000 tons a year. But a deepening of the channel and the enlargement of the locks, so as to reduce the number, might result in a considerable increase in the traffic.

There may be latent possibilities in the traffic of each of these canals we have been considering, but thus far the great bulk of the trade they were intended to get remains undiverted from old routes,

little new trade has been developed, and no important economic results have appeared. This, however, is not the case with the Suez and St. Marys canals.

THE SUEZ CANAL.

In December, 1858, a company was found to undertake M. de Lesseps' audacious scheme of connecting the Mediterranean and Red seas; in the following spring work was commenced, and in 1869 the Suez Canal opened a new water route to the East.

It takes but a glance at the statistics of traffic to notice the enormous difference between the trade that has developed through the Suez Canal and that of the canals already considered. Beginning in 1870, with 486 vessels, having a tonnage of 436,000 tons, there was a steady increase until 1875, when it had reached nearly 1,500 ships and over 2,000,000 tons. After a few years of quiescence came a second period of rapid increase, from 1880 to 1883, in the latter year the figures of 3,300 ships and 5,800,000 tons being reached. Since then there has been a slowly increasing tonnage, reaching the maximum figure of 8,700,000 tons in 1891, but falling off somewhat since that year. In 1896 the figures were 3,409 ships with a tonnage of 8,594,307.*

* The tonnage for the year 1906 will probably exceed 18,000,000.

The importance of these figures may be made clearer by recalling the fact that the foreign tonnage entering at the port of New York has rarely exceeded 7,500,000 tons in any year, and that the foreign tonnage for all the ports of the United States, both entering and clearing, is about 35,000,000 tons; that is, the traffic through the Suez Canal, measured by volume, is almost a quarter of the total foreign trade of the United States. But if measured by value, the importance of the canal traffic is seen to be much greater. The imports and exports of India, via the Suez Canal, are equal in value to $360,000,000, which is nearly one-quarter of the value of the foreign trade of the United States. As the Indian trade constitutes rather less than one-half the total traffic of the Suez Canal, the value of the whole of that traffic must be not far from a half of the foreign trade of the United States.

EFFECT OF SUEZ CANAL ON SHIPPING.

The development of a trade of such an extent and value by a new route within the space of twenty-five years could not but have an important and far-reaching influence on the economic interests of the world. Perhaps the most striking results of the opening of the canal route to the East were those on the machinery of trade — meaning by this term both the material appliances and the business orga

trade. One effect might have been in part anticipated. The new route saved nearly 3,000 marine leagues on the voyage from the ports of western Europe to the East, or almost half the distance to Bombay. The obvious result of the use of the new route would be that half of the vessels engaged in the Eastern trade would be out of employment. In fact, however, the change came more indirectly. Sailing vessels did not find it advantageous to use the canal, and continued on the old route around the Cape of Good Hope. But the canal, by making practicable the use of steamships in the oriental trade, brought about an even greater revolution in the character of the shipping business to the East. By the Cape route coaling places were few, and the facilities for coaling expensive. The consequence was that the enormous expense of coaling at these out-of-the-way places, with the loss of freight room for the extra space needed for coal, made the use of steamers unprofitable. But by the canal route a steamer could coal at Gibraltar, Malta, Port Said, and Aden, where coal could be furnished at moderate rates, while the space saved from coal could be used to carry a larger cargo. Accordingly, a large number of new iron screw steamers were soon constructed for the trade with the East, and replace a large percentage of the sailing vessels. It has been estimated that 2,000,000 tons of vessels were thrown out of employment, and the effect of this

be seen in the immediate reduction in the tonnage of sailing vessels. In 1869 the sailing tonnage in the British foreign trade was 3,600,000 tons; in 1876 it was but 3,230,000 tons.

GREAT ORIENTAL STEAMSHIP COMPANIES.

In the construction of the new steamers for the canal trade two lines already in existence — the Peninsular and Oriental Steamship Company and the Messageries Compagnie — took prominent parts. But new companies also were rapidly organized, which built steamers and established new lines to the East, among which may be noted the British India Steam Navigation Company, the Clan Line, the Austro-Hungarian Lloyds Company, the Italian Steam Navigation Company, and the Rubbotino Company, of Genoa. It is not possible to get at the amount of shipbuilding made necessary by the change in the kind of ships used in the Eastern trade, but some idea of the importance of the change may be seen by noting the fact that the total steam tonnage in the British foreign trade increased from 650,000 tons in 1869 to 1,500,000 tons in 1876. It would, of course, be possible to learn the number and tonnage of ships now engaged in the trade between Europe and the East, but to account for all of this by the Suez Canal would be to exaggerate its effects. Improvements in marine engines and in the construction

of steamers make much longer steamer voyages possible to-day than were possible in 1870, as is shown by the lines to Australia and across the Pacific Ocean. It is, therefore, certain that if no Suez Canal had been built, there would have been by this time steamers in the Eastern trade; but the change would have come at a much later period, and sailing vessels would continue to carry a large, perhaps a dominant, share of the traffic. The effect of the Suez Canal was to make the transition from sail to steam sharp and decisive, and to bring it about in the decade 1870–1880.

AN ANTICIPATED EFFECT NOT REALIZED.

One change in the shipping industry that was expected from the construction of the Suez Canal has not been realized. It was predicted that the geographical advantage given to the Mediterranean ports by the new route would soon enable them to regain the position they had held in the Middle Ages as the carriers of Eastern produce to the markets of Europe. In England it was felt that the canal would seriously threaten British maritime supremacy, but the results have been otherwise. It was only in England that the capital was at hand to build the large screw steamers which alone could profitably use the canal, and from the start three-fourths of the vessels using the canal have been British. Of late years there has

been a slight decline in the percentage of British vessels, but this has been due not to an increase in the ships of southern European nations, but to an increase in German, Dutch, and Belgian vessels.

But while the carrying trade is still in British vessels a much larger and a growing share of the traffic is carried from the East directly to the Continent, and England has declined in relative importance as a warehousing and distributing point for Eastern goods. Under the old *régime* of sailing vessels around the Cape, when voyages from India took a good part of a year, and the time of arrival could not be calculated on within a month or two, it was necessary that large stocks of goods should be kept on hand to enable dealers to meet the varying demand for their goods. Steamers by way of the Suez Canal make the voyage in thirty days and the time of their arrival can be regulated within a day. Shorter voyages and punctuality of arrivals make it possible for local dealers both in England and on the Continent to order directly from the East and the change in the method of this business rendered useless to a large extent the immense warehouses at London, Liverpool, and other English ports. A few statistics will show the extent to which direct trade between the East and the Continent has taken the place of trade via England. In 1870 the value of exports from India to the United Kingdom was nearly $70,000,000, to the rest of Europe $13,000,000; in 1893–94 the

value of Indian exports to the United Kingdom was $93,000,000, to other European countries $85,000,000. In other words, while the total export trade of India and the total exports to Europe have doubled in value within twenty-three years, and the exports to European countries other than Great Britain have multiplied sixfold, the exports from India to the United Kingdom have increased but 40 per cent. The proportion of Indian exports to Europe, that are landed first in the United Kingdom, declined from 83 to 53 per cent.

DIRECT EXPORTS FROM INDIA TO EUROPE.

This change in the direction of trade has not been simply the transfer of the distributing points from England to the Mediterranean ports of southern Europe. The towns of Italy, Greece, and southern France have been almost as greatly disappointed in their expectations of becoming trade centers as in their hopes of controlling the shipping trade to the East through the operation of the Suez Canal. To be sure there has been a heavy increase in Indian exports to Italy, Austria, and Russia; and the Mediterranean ports, notably Genoa, have increased in importance. But the most striking feature of the change in the direction of Indian exports lies in the increased traffic to France, Holland, Belgium, and, above all, to Germany. The statistics of Indian ex-

ports to these countries show that there is no longer any one country pre-eminent as a distributing point for Eastern produce, but that all Europe trades directly with the East. Nevertheless, with this great change in the character of the Indian export trade the imports of European goods to India continue, as in the days before the canal, to come almost entirely from England.

The termination of the warehouse distribution system of England was one of the forces which led to the disappearance of the class of merchant princes who had hitherto monopolized the Eastern trade. The system of bank discounts and commercial loans, by enabling men of ability to secure capital at low rates of interest, also played a large part in driving out of trade the old houses doing business on their own capital, from which they expected large rates of interest. But as long as large stocks of goods had to be kept on hand for six months or more at a time, it was difficult for the new business man to get the credit that would enable him to supplant the old-established houses in the eastern trade. When, however, the new route by the Suez Canal, by bringing steamers into use, enabled a cargo to be sold and delivered within a month after the order had been sent the advantages on the side of the man working with borrowed capital were decisive.

As a result of the opening of the Suez Canal sailing vessels, warehouses, merchant princes, dealers in

six months' bills found their old occupations slipping away. The old modes and channels of business were altered and new adjustments had to be made. In the meantime the confusion and disturbances in the business world were so great that the London Economist has said that they constituted one great general cause for the universal commercial and industrial depression and disturbance of 1873.

The effect of the opening of the Suez Canal and the new route to the East on the production and marketing of Eastern produce is by no means so easy to trace as the effects on the machinery of trade. If all the necessary statistical material were at hand it would be an almost endless task to disentangle from the complex results of complicated causes the exact changes that have been due to the canal. It is possible, however, to see the effects produced by the canal in the case of a few leading commodities, and in other respects the general tendency of the new route can be recognized.

EFFECT ON CERTAIN COMMODITIES.

A few commodities will serve to show that not every article in the Eastern trade has been affected by the new route and the new methods of business brought about by it. The exports of Indian cotton have remained at about the same figure since the opening of the canal, showing that for that article

the sailing vessel and the Cape route provided as cheap a road as the canal route. The exports of Indian wool and of spices have increased to some extent, but with nothing to indicate that the increase is greater than would have taken place in the ordinary development of trade. The exports of tea from India show an astonishing increase from 11,000,000 pounds in 1870 to 120,000,000 in 1893–94. But with an article of such high value the direct effects of the canal through cheaper freight rates can have had little influence here, though indirectly the increased Indian production may be due in part to the easier communication with the West that was made possible by the canal. In the earlier arrival of the new season's teas the influence of the canal in shortening the time from India to England is clearly evident. Tea imports to England in July, 1870, were 711,000 pounds; in July, 1871, 4,000,000 pounds; in July, 1872, 23,000,000 pounds — the enormous increase being the direct result of the use of steamers via the canal in place of sailing vessels and the long Cape voyage.

Rice is a commodity the trade in which has been subject to important changes as a direct result of the use of the canal route to the East. Rice is a staple Italian cereal and a leading article of Italian export. It had formerly been imported into European countries by the Cape route, but by the canal route Eastern rice was enabled to reach markets in southern

Europe formerly inaccessible, and even to be sold in Italy itself, much to the displeasure of the Italian producers. In the six years following the opening of the Suez Canal the export of Indian rice doubled and has continued to increase since. It constitutes the largest single item in the export trade of India.

INDIA AS A WHEAT-EXPORTING COUNTRY.

The creation of the wheat export trade of India is due directly to the opening of the Suez Canal route to Europe. Efforts had been made to carry wheat around the Cape, but the liability to heat during the long voyage and the loss from weevil in the cargo made all such attempts unsuccessful. The possibility of carrying wheat by the new and shorter route was soon demonstrated, and a trade was established that has grown until India has become the second wheat-exporting country in the world. In 1870 the wheat exports of India were 130,000 bushels; in 1876, over 4,000,000 bushels; in 1883, 35,000,000 bushels; in 1891, 50,000,000 bushels.

Since the last date there has been a considerable decline in the extent of the export owing to poor crops, but under ordinary conditions the Indian product is an important item in the wheat market of the world. It will be observed that the great increase in this Indian export trade did not begin until after the year 1876. The extension at that time came

about through the reduction in freight rates made possible by improved steamers. It is nevertheless true that the establishment of the wheat export trade of India and the possibility of any such trade existing at all is to be ascribed to the Suez Canal.

Of the imports into India the direct influence of the Suez Canal seems to be striking in the case of but one commodity — petroleum from the Russian oil fields at Batoum. Before the discovery of these fields the imports of oil into India were insignificant. The value of such imports in 1869 was about $110,000 and in 1876 had risen only to $175,000. But when the Batoum oil fields were discovered an extensive trade to India, via the Suez Canal, immediately developed. In 1880 the imports of oil into India were 6,500,000 gallons, valued at $1,360,000; in 1885 this had risen to 26,300,000 gallons; in 1890, to 51,800,000 gallons, and in 1893, to 86,600,000 gallons. For a considerable period the Indian demand absorbed more than half the total product of the Russian oil wells, and to-day it takes more than a quarter of their output. As the distance from Batoum to India around Africa is as great as that from the American oil fields, it does not seem possible that any of this Russian oil would have found its way to India by the Cape route. Some trade might have arisen by the overland route to India, which, when railroad connections from the Caspian Sea to India are complete, would have become important, but the

oil imports of India as they stand to-day are made possible only by the existence of the canal route.

It may be well while dealing with particular commodities to note that nearly 1,000,000 tons of coal are annually brought to Port Said for the steamers passing through the canal. This coal makes a considerable item in the Mediterranean trade due to the Suez Canal.

If the question be asked, What is the total significance of the Suez Canal on the production and marketing of commodities? the answer can be given only in general terms. A superficial observer might base an estimate on the increase in Indian trade with Europe from $280,000,000 in 1870 to $700,000,000 in 1894. If, however, it is borne in mind that this increase has been at a less proportionate rate than that from 1850 to 1870 without the canal, and if the large extensions of the foreign trade of Australia, South Africa, Argentina, and the United States within the last twenty years are also remembered, it must be evident that other and more general causes than the opening of the canal have affected the development of India. On the other hand, to limit the effects of the canal to those results which can be directly traced, such as the development of the trade in rice, wheat, and petroleum, is to err by understatement. The greater ease of communication by the canal route has brought much more Western life into personal contact with the East, and this has had

much to do with the development not only of the foreign trade of the Eastern countries, but also of their internal resources. One phase of this general development in which the canal has had an indirect share may be seen in the tonnage statistics of some of the Eastern countries. From 1870 to 1894 the total foreign tonnage of India rose from 4,000,000 tons to 7,660,000; of Ceylon from 1,420,000 tons to 6,360,000 tons; of the Straits Settlements from 1,650,000 tons to 10,000,000 tons; of Hongkong from 2,640,000 tons to 10,460,000 tons. How much of this increase is to be ascribed to the canal and how much to other causes can not be calculated or even roughly estimated. We must remain content, in this part of our inquiry, with recognizing that the canal is one of the factors in the great economic development of southern Asia.

To recapitulate: The construction of the Suez Canal has led to the immediate and rapid development of the use of steamers in the Eastern trade, has brought about the disuse of most sailing vessels in that trade, has caused the decline of the warehouse distribution system of England, and the rise of a direct trade between the East and the consuming countries of Europe. The shorter and more direct route has also made possible the wheat export trade of India, and the trade in oil from Batoum to India, and has doubled the rice exports of the latter country. The canal has also been one of the many factors in

other important economic changes, among which may be mentioned the crisis of 1873 and the general development of trade and industry in the East.

THE ST. MARYS FALLS CANAL.

There has been a canal around the falls in St. Marys River between Lake Superior and Lake Michigan, available for vessels drawing not more than 12 feet of water, from 1855 on, but fifteen years later the average annual increase of 21 per cent. of each year's freight traffic over that of the preceding year made it so evident the canal would soon be inadequate for the increasing commerce that the United States Government began improvements, and by 1881 had completed a 17-foot channel between the lakes, and provided a 515-foot lock, with a single lift of 20 feet, for carrying vessels from the level of one lake to that of the other. The continued growth of the traffic led to an improved 20-foot channel, provided with an 800-foot lock in 1896. Following the example of the United States the Dominion Government built a canal around the Canadian side of the falls in 1895.

TRAFFIC OF SUEZ AND ST. MARY'S CANALS COMPARED.

The volume of traffic through this canal far ex-

ceeds that through the Suez Canal. In 1881 the traffic of the old St. Marys Falls Canal was 1,560,000 tons, as against 4,130,000 tons through the Suez Canal; but with the enlargement of the American canal a rapid increase in traffic immediately developed. By 1889 it equaled that of the Suez Canal (about 7,000,000 tons in each); in 1895 a tonnage of 15,000,000 tons went through the St. Marys Falls Canal, as compared with 8,500,000 tons through the Suez Canal; and in 1901 the figures for the St. Marys Falls Canal were 28,403,065 tons.* The present traffic through the American canal exceeds the total foreign trade of the port of New York and is equal to nearly half the total volume of the foreign trade of the United States. In value the traffic through St. Marys Falls Canal presents less imposing figures, though even in this respect it is by no means insignificant. The value of the freight passing through the canal in 1896 is estimated at $195,000,000, and in 1901 at $290,000,000.† The Indian traffic alone through the Suez Canal in 1896 is valued at $360,000,000. Nevertheless, a trade increasing

* In 1905 they were 36,617,699.

† The discovery and utilization of the mineral wealth of the Great Lakes region, supplemented by timely appropriations by Congress for the improvement of navigation, have brought about a maritime growth in that portion of our country which is without parallel in maritime history. Our lake fleet alone is greater than the fleet of any foreign nation except Great Britain or Germany.

nearly $100,000,000 a year within a period of five years, may, prima facie, be expected to have had important economic effects.

As in the case of the Suez Canal the most striking results have been on the machinery of trade, the influence of the St. Marys Canal on the shipping industry of the Great Lakes being especially marked. It is not too much to say that the development of the carrying trade on the Great Lakes both in the number and kind of vessels used is due almost wholly to the "Soo" Canal. From 1881 to 1895 the volume of commerce through the Detroit River increased from 17,500,000 tons to 29,000,000 tons. During the same period the volume of commerce through the St. Marys Falls Canal increased by 13,500,000 tons, and as the larger share of the canal traffic goes through the Detroit River to Lake Erie ports, the increase in the traffic through the Detroit River is seen to have been mainly in the traffic from Lake Superior made possible by the existence of the canal and locks at Sault Ste. Marie. This increase in traffic has meant a corresponding increase in the number of vessels in the lake-carrying trade, and probably half of the 3,230 vessels on the lakes are employed in business depending on the canal. Between 1883 and 1897 the total tonnage on the lakes increased from 720,000 to 1,410,000 tons, the increase being more than the total increase in the American merchant marine during this time. Further, while in 1883 the lake ton-

nage was but a sixth of the total American merchant marine, in 1897 it was nearly two-sevenths of that total.

CHANGES IN THE LAKES SHIPPING.

Not only has there been this increase in traffic and shipping due to the canal, but within the last ten years there has been a rapid and striking change in the material and structure of the ships on the Great Lakes, which could hardly have taken place had it not been for the canal. There has not been any sudden displacement of the old vessels such as was occasioned by the Suez Canal, but the new ships built for the increased traffic and to replace those that were out are not sailing vessels of wood, but large steel and iron steamships with double bottoms, water-tight compartments, triple-expansion engines, and modern electrical appliances. In 1870 there were 1,699 sailing vessels and but 642 steamers on the lakes; in 1897 there were 993 sailing vessels and 1775 steamers. In 1870 the average tonnage of vessels on the lakes was 175 tons; in 1897 it was 440 tons. In 1880 a 1,000-ton vessel was a rarity. In 1895 there were five lines owning together 60 steamships of from 1,750 to 3,000 tons, and in 1901 over 100 steamers and sailing vessels from 5,000 to 8,000 tons, and 10 over 8,000 tons.

The "Soo" Canal is connected in two ways with

these changes in the lake shipping. In the first place, the increase in lake traffic, which has necessitated large numbers of new ships and thus hastened the introduction of larger and modern ships, has been, as we have seen, mainly in the traffic from and to Lake Superior, made possible by the canal; in the second place, the iron ore from which the iron and steel ships are constructed comes from the iron mines of northern Michigan and Wisconsin, which have been made available by the canal route from the mines to the ports in the southern lakes.

EFFECT OF "SOO" CANAL ON IRON BUSINESS.

The mention of these iron ores brings up the second phase of the economic effects of the "Soo" Canal — those on the production and marketing of commodities. The case of iron and steel may well be given the first place as the largest item in the traffic through the canal. The most striking features in the iron and steel industries since 1880 have been the decline in the importance of the Pennyslvania mines, the development of the Lake Superior region, and the transfer of the manufacture of pig iron and steel from the east to the west of the Alleghenies. Several factors have served to bring about this remarkable shift. The Superior ores are of the quality available for making steel by the Bessemer process; the large deposits have made profitable the use of labor-saving

machinery in mining and the construction of special terminals for loading and unloading the ore. But an equally important factor is the low rates of freight from the mines to the manufacturing points in Ohio, western Pennsylvania, and Illinois by the water route through the canal. In 1895 the rate from the mines to Erie ports was 80 cents per ton, equal to nine-tenths of a mill per ton-mile. The lowest railroad rate per ton-mile would equal a charge of $2.59 a ton from Duluth to Cleveland; and as the price of red hematite ore of Bessemer quality at Cleveland in 1895 was $2.80 a ton, the dependence of Lake Superior ore on the water route may be easily seen.

An interesting case of interacting causes is to be seen in the relation between the Lake Superior iron mines and the shipping on the Great Lakes. It was the developemnt of the iron mines which furnished the trade of the large steel steamships, and also the material for constructing them, while the use of the larger and better ships has lowered freight rates and still further developed the iron industry.

The development of the Lake Superior iron mines has been an important factor in causing the great reduction in the price of Bessemer steel during the last sixteen years, and it is this reduction that has made possible the largely increased use of steel in shipbuilding, in bridges; in heavier rails, and in the tall buildings of our large cities. Indirectly, then, all these improvements have depended to a large degree

on the existence of the St. Marys Falls Canal. The extent of this relation may be indicated in some degree by the statistics of the iron-ore movement through the canal. From 1860 to 1881 the amount of iron ore passing through the canal increased from 100,000 tons to 750,000 tons per year, but since the construction of the larger lock the increase has been at a much greater rate. In 1887, 2,500,000 tons went through the canal; and for each of the years 1895, 1896, 8,000,000 tons; and in 1901, 18,000,000 tons. Throughout the period since 1881 the traffic in iron ore has formed about one-half the total tonnage passing through the canal. The figures for 1895 and 1896 are equal to four-fifths of the total production of the Lake Superior mines, which in turn constitutes two-thirds of the total iron-ore output of the United States.

ENORMOUS WHEAT TRAFFIC OF THE LAKES.

The most important part of the traffic through the "Soo" Canal, however, is not iron ore, but wheat and flour and other grains. The value of these items in the canal traffic is one and a half times that of the iron ore, and equal to $84,000,000, or nearly a third of the valuation of the total commerce through the canal. In volume the traffic has grown from 3,500,000 bushels of wheat and 600,000 barrels of flour in 1881 to 63,250,000 bushels of wheat

and nearly 9,000,000 barrels of flour in 1896. The last figures account for a large fraction of the 467,000,000 bushels of wheat raised in the United States in 1896, being in fact almost equal to that portion of the crop exported. The movement of wheat through the canal just about equals the total receipts at Buffalo and Erie.

It is not, however, possible to give the canal alone the credit for having developed this wheat trade. The production of the wheat was only made possible by the construction of railroads through Minnesota and the Dakotas, and these same railroads provide a means of getting the wheat to market via Chicago. But if all-rail rates had to be paid, Minnesota and Dakota wheat and flour could not compete so well with that from the country near the eastern markets as it does by having water rates from Duluth to Buffalo. It should also be borne in mind that railroad building in Dakota and Minnesota began on a large scale only after the enlargement of the canal, when it was seen that they could connect with a through direct water route to Buffalo. The canal has therefore been an important factor in developing wheat production in the country west of Lake Superior.

Besides wheat there has been a considerable traffic in other grain, but this first assumed large dimensions in the year 1896, when 27,000,000 bushels of grain other than wheat went through the canal, as against

8,000,000 bushels in the previous year. As yet this is a less important item than that of wheat, but the relations between the canal and the development of the traffic are the same in both cases.

DEVELOPMENT OF LUMBER TRADE.

The same relations can also be traced in the development of the lumber traffic. This grew from 82,000,000 feet in 1881 to 685,000,000 feet in 1896. As in the case of wheat, a considerable increase would have resulted from the construction of railroads, but the construction of railroads has been hastened and increased by the existence of the water route to the East through the canal, and it is only by cheap water rates that such a huge traffic has been developed. If, however, the cutting down of forests is the true explanation of the destructive spring floods in the Mississippi Valley, the encouragement given to the lumber traffic by the canal may not, after all, have been of economic advantage to the country as a whole.

The other important item in the south-bound traffic through the canal does not seem to have been dependent on the canal. The amount of copper going by this route increased from 29,000 tons in 1881 to 116,000 tons in 1896; but the cheaper freights made possible by the canal can have had little effect in promoting the production of an article valued at $200 a ton.

Of the north-bound traffic the only item of large dimensions is that of coal. In 1881, 295,000 tons of coal passed through the canal; in 1896, over 3,000,000 tons. The whole of this traffic may be said to have been created by the canal. The lowest railroad rates would be too high to allow any coal to be carried to the country around Lake Superior, but the lake steamers, going back empty for their cargoes of iron ore and wheat, can afford to carry coal at rates which seem incredible. In 1890 the average freight rate on coal from Buffalo to Duluth was 45 cents a ton. It is through such rates that the northward movement of coal and the consequent development of a large iron manufacturing industry near the ore mines are made possible.

INCREASES OF POPULATION DUE TO THE CANAL.

The geographical changes in production that have resulted from the operation of the St. Marys Falls Canal have been accompanied by important movements of population. A definite connection can be shown between the canal and certain particular population movements, but with other changes the canal has been only one of several factors. The increase of population around the shores of Lake Superior may fairly be ascribed to the development which has been given to that country by the canal. Taking the counties bordering on Lake Superior, we find that from

1880 to 1890 the population of the Michigan counties increased from 61,750 to 116,600; of the Wisconsin counties, from 8,000 to 41,000, and of the Minnesota counties, from 6,400 to 54,700. The total increase is not a startling figure in the United States, but compared with the percentage increase in these same States as a whole the result is striking. During the decade the population of Michigan and Wisconsin increased in each case about 27 per cent, and of Minnesota about 70 per cent; in the Lake Superior counties the percentage of increase was, in Michigan 90 per cent, in Wisconsin 400 per cent, and in Minnesota 800 per cent. The only explanation of the difference is that new lines of industry have been opened up by the larger "Soo" Canal. One conspicuous feature of this increase of population in the Lake Superior region is the development of cities. Of the total increase of 136,000, 72,000 occurs in the six cities of Duluth, Superior, Ishpeming, Ashland, Marquette, and Iron Mountain. Duluth, from a town of 3,500 in 1880, had become a city of 33,000 in 1890, and six years later had a population of 60,000. Ishpeming increased during the ten years from 6,000 to 11,000; Superior, from 4,700 to 9,000, while the other three places were not in existence in 1880, but had populations between 8,500 and 12,000 in 1890.

Among the movements of population where the effects of the "Soo" Canal have been greater but are

not so exactly calculable, may be mentioned the settlement of the Red River Valley and the increase in the cities on and near the southern shores of Lake Erie. The first of these is connected directly with the development of wheat production in that region, in which, as has been seen, the canal had a most important influence. The second is due, in large part, to the development of the iron and steel manufacturing industries, brought about by the use of iron ore from the Lake Superior region.

INFLUENCES OF ST. MARY'S AND SUEZ CANALS.

A comparison of the influence of the St. Marys Falls Canal with that of the Suez Canal, shows that both have led to a rapid change in the material and character of ships used, that brought about by the Suez Canal being the most important, both in the extent of new shipping and in the consequent dislocation of old forms of industry. Both canals, too, have led to important changes in the sources of production of several commodities, and the effects of the American canal on iron and wheat production are greater than any effects traceable to the Suez Canal. In the case of the more general changes in which the extent of the influence of the canals can not be measured, no accurate comparison between the two is possible, but considering the greater area and population in Asia

affected by the Suez Canal, it is evident that its influences on general development have been greater.

Both canals have led to the production of wheat on a large scale in areas hitherto unused for that purpose, these districts constituting a large part of the total increase in the area devoted to wheat production. In consequence of this total increase of wheat-raising area during the last fifteen years, and the cheaper transportation to European markets, there has been a large reduction in the normal price of wheat. Cheaper food and less distress from famines and the fall in prices received by farmers in the old wheat-producing districts have been due in no small degree to the canals.

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